HOUSE DRAINAGE.

BY WM. PAUL GERHARD, C. E.

(*Concluded from page 41.*)

Overflow pipes are, as a rule, objectionable; the same is true of any waste pipe not in constant use.

Overflow pipes, if such are used for fixtures, must connect to the waste pipe on the inlet side of the trap or below its water level, or else they must discharge over a "safe."

Overflow pipes from water tanks should discharge into the gutter of the roof, or else empty over some sink in a lower story. Never should they have direct connection with any waste, soil, drain or vent pipe.

FIG. 3.

The water in all traps under any kind of plumbing fixture must be frequently changed.

Stagnation of water or air should be avoided, not only in the drains and vent pipes, but in the traps as well.

It is useful, and where cost is no objection, advisable to ventilate the house side of the traps and overflow pipes by a vent pipe, running into some *special* flue, constantly heated for such purpose. A draft is thus created from

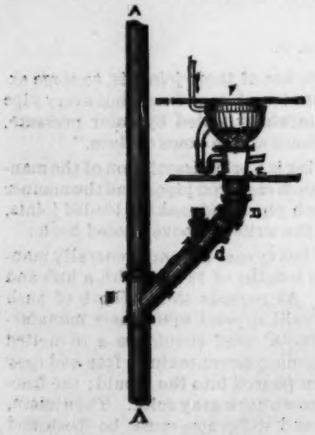


FIG. 4.

the room, through the fixtures, into the heated flue, and any gases given off at the house side of the water-seal may thus be effectually removed.

Drip pipes for safes under fixtures should not have any connection whatever with any soil or waste pipe or drain. They should be collected in the basement or cellar and discharged over an open sink, so that any leakage may be at once apparent.

Refrigerator wastes must never be directly connected to any soil, waste or drain pipe. These wastes are very apt to become coated with slime and dirt in a short time; they frequently stop up, and are generally liable to become offensive, especially if the ice used is very impure.

The outlets of all "set" fixtures except water closets should be protected against obstruction or chokage by a fixed strainer.

Water closets, urinals and slop sinks or slop hoppers must not be supplied with flushing water directly from the main supply pipe. They should be flushed from small cisterns placed over each fixture or over each group of water closets or urinals.

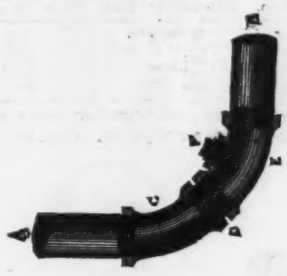


FIG. 9.

In public buildings or public places it is preferable to make the flushing independent of the carelessness or forgetfulness of the user by arranging for automatic flushing either immediately after use of the fixture or else at fixed intervals.

Grease traps are to be recommended for kitchen and pantry sinks of large buildings, such as hotels, eating houses, cooking establishments, etc. For small households grease traps are unnecessary, and the waste pipes may be kept clean by occasional flushing with a concentrated solution of potash.

Openings in the cellar floor, connecting to

FIG. 11. FIG. 12.

the house drain, are highly objectionable, unless trapped by some deep trap, the water seal of which is not easily lost through evaporation. In localities subject to back-water from tides a flap valve or ball valve may be required.

Better than either arrangement is a pipe, carried up from the main house-drain to the cellar floor, and closed tight by a plug screwed into the outlet of such pipe, which plug may be removed should it become necessary to carry off water from the cellar floor.

There should be as little plumbing in a building as possible, but what there is should be *perfect*.

We shall now consider the *special features of the Durham System of House Drainage*, first, as regards *construction*; second, as regards *materials* used.

1. *Construction.*

In a pamphlet describing his system, Mr. C. W. Durham, C. E., has truly said: "*Proper mechanical* construction must be the foundation of any good system of drainage." * * "By the use of wrought-iron pipes and screw-joints we construct a drainage apparatus within the building, which is gas and water-tight as regards the joints; rigid, yet elastic; entirely independent of walls or floors for support, and absolutely invulnerable. As a structure, it will last as long as any building will stand—*without any outlay for repairs.*"

"When lengths are screwed together in a wrought-iron coupling, the joint is as strong as any other part of the pipe, and they will stand up vertically, from a solid base to the height of any building without lateral support."

"The result attained is a system of pipes which are independent of the building for

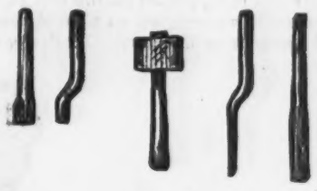


FIG. 13.

support; which cannot be cracked or broken; and whose joints are permanently gas-tight beyond the shadow of a doubt."

The following illustrations, some of which are taken from the writer's book, "Hints on the Sewerage and Drainage of Dwellings," illustrate the chief features of construction. Fig. 3 shows a soil pipe stack as constructed and erected by the Durham Company.

A is the running trap on the main house drain, with cleaning holes and a fresh-air pipe, B, on the house side of the water seal, carried to a point remote from windows, or to the street curb. C is the soil pipe elbow on which the whole straight soil pipe stack, FF, is erected independent of walls or partition. E is a plug in the soil pipe ell to remove any obstruction which may happen at this bend. D is a 4"x2" Y branch for a sink waste, G a 4"x2" double Y branch for bath and bowl wastes; H is a double cross with grade, and LL are branches from water closets, which rest on the iron flanges KK.

Figs. 4, 5, 6 and 7 show the manner of supporting the water-closet, the chief plumbing

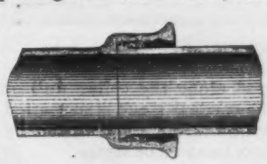


FIG. 14.

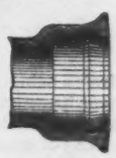


FIG. 15.

fixture in a dwelling, directly from the soil pipe, independent of the floor, on special elbow fittings or water-closet flanges, KK. This is especially important for water-closets with trap above the floor, as in the common system the joint at the floor is liable to open through shrinkage and settlement of floors or joists. Fig. 4 shows how closets at a distance from the soil pipe are supported on a cast-iron base, to which they are securely attached. This cast-iron base rests on the floor, but its waste pipe is connected to the soil pipe by a *flexible* joint. A settlement of the floor and a subsequent sinking of the cast-iron base, holding the water-closet, cannot loosen or open the joint at the soil pipe. Fig. 5 shows a water-closet with a trap above floor, supported on the branch from the soil pipe. Fig. 6 shows a trapless closet supported in the same manner. Fig. 7 shows the manner of supporting water-closets, requiring a trap *below* the floor.

The illustrations purposely show different fittings on the soil pipe, and different ways of running the branches from the soil pipe to the water-closet. From these sketches it is, fur-

thermore, evident that any *good* form of water-closet can be used in connection with the Durham System. We advise in every case against the use of the ordinary "pan closet" as being an entirely unsanitary fixture which becomes extremely foul after some use.

Fig. 8 shows the manner in which the wrought-iron soil pipes, A. are screwed into the elbow fittings, D, which connect them with the underground drain, F, (the same fitting is shown in Fig. 3 at C.) It will be noticed that the change in the direction of the flow is effected with an easy curve. Fig. 9 illustrates the same junction between soil pipe and drain where the latter is of wrought-iron and carried along the cellar wall. In both cases the construction provides for hand-holes closed by plugs for removal of accidental obstructions.

In the former case the whole weight of the vertical stack is supported on the soil pipe ell which must be securely set on a solid foundation of concrete or masonry. In the case of drains being carried along the cellar wall or near its ceiling, the vertical stack is supported at the junction with the horizontal drain by means of strong iron hangers or straps.

As the wrought-iron pipe is brought into the market in lengths up to 20 feet, the number of joints of each stack of soil or waste pipe is largely reduced. It is generally possible to *run from floor to floor without intermediate joints*, and this effects not only a saving in labor, but reduces the dangers from imperfect joints.

2. *Materials.*

For all soil, drain, waste, and vent pipes, and for leaders (conductors), in fact for all pipes above ground, the Durham System uses the asphalted standard *wrought-iron*, lap-welded steam pipes. The following is taken from the writer's book "Hints on the Drainage and Sewerage of Dwellings:"

"Wrought-iron pipe is extensively manufactured by many "tube works" at the rolling mills, in lengths of about 20 feet. Bars of wrought-iron of a width corresponding to the circumference of the pipe, are bent up by means of powerful machines, while in a red heat to a circular shape. The ends of the smaller sizes (up to 2 inches diameter) are made to butt against each other, while the larger sizes lap over. The bars are then again highly heated and welded together, after which operation they are adjusted so as to be exactly circular in shape.

Before leaving the works, and while hot, the wrought-iron pipes are immersed in a tank, containing hot liquid asphalt, which coating of the pipes effectually protects their inside against corrosion. All standard wrought-iron pipes are tested at the works by hydraulic pressure up to 500 lbs. per square inch, and a guarantee of good durable material is thus secured.

The following table exhibits the size, thickness and weight of pipes, used for soil and vent pipes:

Size of Pipe.	Thickness of Pipe.	Wt. in lbs. per ft.
2"	.154 inches.	3.87
3"	.217 "	7.60
4"	.237 "	10.73
5"	.259 "	14.56
6"	.280 "	18.77

Such pipes are put together same as the steam pipes, with *screw joints*. (Fig. 10.)

The screw thread, cut externally on the pipe, is slightly tapering, and so is the internal thread cut on the fittings. It is customary for pipes from 2 to 6 inches diameter to have 8 screw threads per inch. These threads were formerly cut on a lathe, if done by machine work; if by hand, by the use of die-stocks. Since a number of years large hand and power pipe-cutting machines have been manufactured, which use dies and cutters, by which a large saving in time may be effected. Instead of cutting internal threads of fittings in a lathe, they are now tapped by powerful tapping machines.

Wrought-iron pipes are screwed into couplings, or into fittings by means of pipe-chain tongs (see Fig. 11), on which a man can exert a powerful leverage, thus securing the great desideratum, *tight* joints.

In order to make up for imperfections in the threads of the pipe and fittings, a paste is used in making the joints, consisting of an equal mixture of white lead and linseed oil with red lead. This paste hardens after some time, and forms a tight packing in the screw-joint.

The pipes are cut to required lengths from exact measurements, in a power pipe-cutting and threading machine. Straight lengths of pipe are screwed together by means of wrought-iron couplings; for changes of direction, special fittings, such as elbows, T and Y branches are used, which will be described later.

For drains *underground* the Durham System uses heavy *cast-iron gas pipe*, with leaded joints.

To quote from Mr. Durham's pamphlet:

"Lead joints and cast-iron drains are employed only for pipes in a *horizontal* position, in which there can be no *pulling* strains. All other joints are *screw* joints, made with wrought-iron pipe."

The company advises, in every case, against the use of earthen pipes under and inside of a dwelling house, and agrees entirely with the opinion of Capt. Douglas Galton, an experienced engineer, who says:

"The use of cast-iron for house drains, if the cast-iron is solid, sound and free from porosity, will prevent leakage and sub-soil tainting beneath the house, and will be as cheap as earthenware pipes in many cases." • • • "Lead joints can only be made in a strong iron pipe, and the use of these joints is, to some extent, a guarantee of soundness, but every pipe should be carefully tested by water pressure, to see that there are no holes or flues."

The following is a brief description of the manufacture of such cast-iron pipes, and the manner of laying such pipes and making leaded joints, taken from the writer's above quoted book:

"Pipes of heavy cast-iron are generally manufactured in lengths of 12 feet, with a hub and spigot end. As regards the strength of such pipe, much will depend upon their manufacture. The metal used should be a re-melted pig-iron of homogeneous texture, free and easy flowing when poured into the mould; the fracture must show a dark gray color. Then again, great care and diligence must be bestowed upon the making and drying of the pipe moulds and cores; the loam and sand should be carefully chosen, in order to form smooth and substantial moulds.

It is now pretty well understood by all manufacturers of first-class cast-iron pipe that the pipes should be cast over end, in order to obtain a *uniform* thickness of shell, which is the great desideratum for all pipes. If cast in a lying or inclined position, the molten metal poured into the mould has a tendency to float the core and bend it upwards in the centre,

FIG. 17.

FIG. 23.

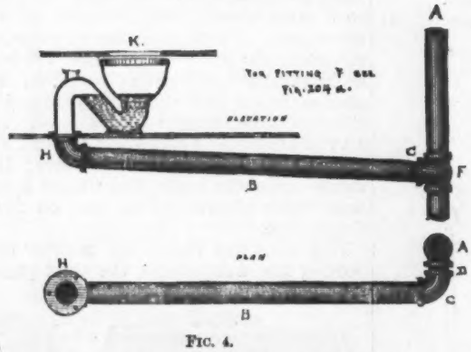


FIG. 4.

FIG. 22.

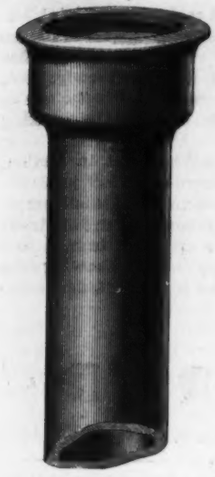
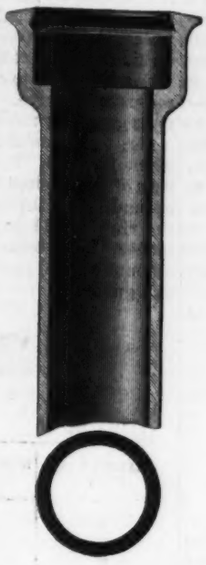


FIG. B.



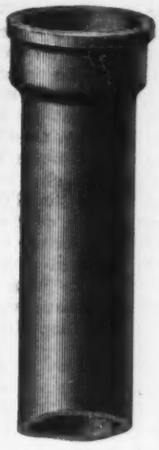


FIG. A.

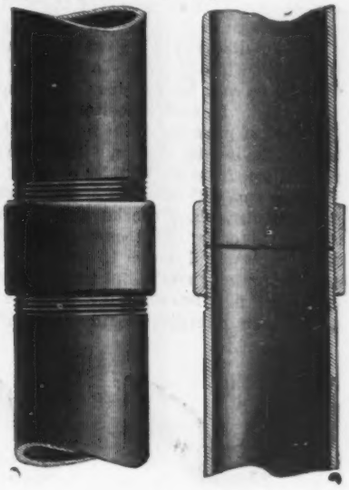


FIG 10.

FIG. 7.

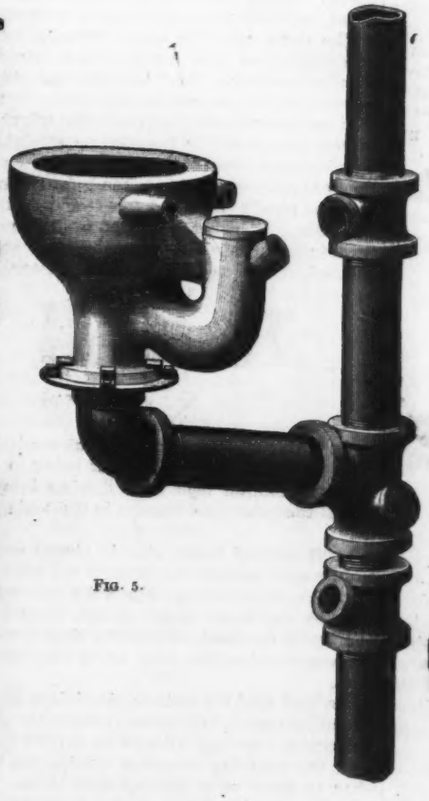


FIG. 5.

FIG. 8

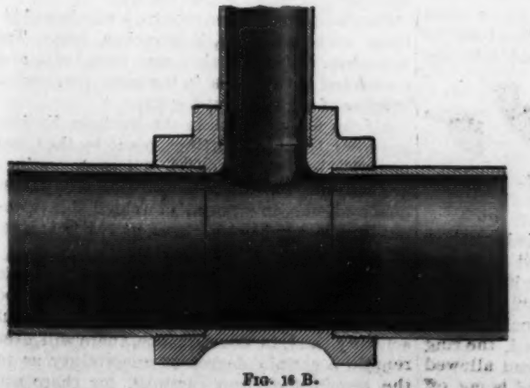


FIG. 16 B.

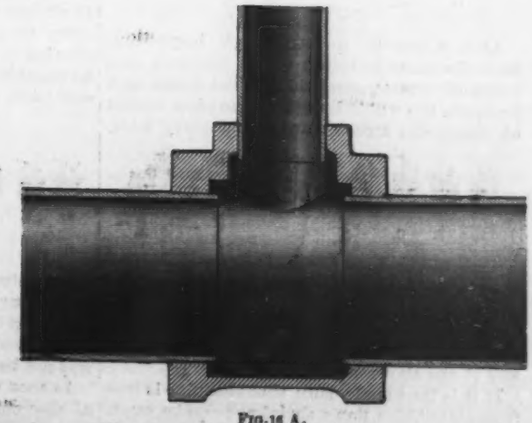


FIG. 16 A.

DURHAM SYSTEM OF HOUSE DRAINAGE.

consequently the thickness of the shell will be much greater at the lower part of the pipe.

Experts disagree in regard to the position of the socket while casting. In England it is customary to cast heavy pipes with the socket downward. In such a position, it is claimed, the head of pressure of the fluid metal, equivalent to the length of pipe, will secure a strong socket, free from air bubbles or other defects. The top end will often be spongy, containing floating dirt, slag, scoriæ and air bubbles. Should this occur with socket or the bell end of the pipe, it would render the socket weak and often worthless for caulking purposes, while the spigot end may be cut off if necessary. A large dead bead is often given to the spigot end of pipe,

FIG. 18.

FIG. 19.

which is afterwards removed by cutting. In Germany, on the other hand, the custom prevails of casting pipes socket upwards. In the United States of America, the general practice is to cast all pipes from 3" to 12" diameters, socket upward, while larger sizes are always cast socket downward. There are, I believe, practical advantages, such as easier drawing and removing of patterns, which influence the American foundries to cast with socket upwards.

After being cast, all pipes should be carefully protected from sudden chills, the cooling should be gradually and slow, so as to avoid imperfections in the metal. After cooling off the pipes are carefully cleaned with steel wire brushes and scrupulously inspected.

FIG. 20.

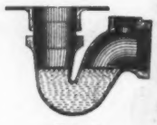


FIG. 29.

All such pipes should be straight, truly cylindrical of a uniform thickness, of a uniform and homogeneous texture, of *perfect smooth surface*, free from flaw or other imperfections, and the spigot end should truly fit the hub of the pipe. The pipe must not be brittle, but must allow of ready cutting, chipping, drilling or threading.

The thickness of metal of cast-iron pipes, used for sewerage purposes, should be about as follows:

2	inch	pipes		5/16	inches thick.
3	"	"		5/16	" "
4	"	"		3/8	" "
5	"	"		7/16	" "
6	"	"		7/16 or 1/2	" "

After a careful and thorough inspection, each pipe must be tested under pressure in a hydraulic testing machine. Whilst under such pressure, the whole length of the pipe should be repeatedly struck hard with a heavy ham-

a. b. c. d. e. f. g. h.

FIG. 21.

mer, in order to detect flaws or weak parts of the pipe shell. If the sound of the hammer striking the pipe metal is clear or bell like, it is a pretty sure indication of the absence of any of the above imperfections.

If it is thus made sure that the pipe is free from air bubbles, flaws, shrinkage-cracks, sand-holes, etc., the pipe must be coated in order to protect it againt corrosion. The best solution known for cast-iron pipes is Dr. Angus Smith's patent coal-tar varnish. After placing the pipes in an oven, they are heated so as to well open the pores, and the solution is likewise kept hot in a tank, care being taken that it does not get too great a consistency. The pipes are then immersed in a bath for about 15 or 20 minutes, then removed, when the surplus of varnish is allowed to drip off from the pipe. There should be only a thin smooth coating of varnish over the pipe. The pipes are now ready for use.

A word of caution seems appropriate in regard to failures of cast-iron pipes through rough handling during carting, or loading and unloading. Great care must be taken not to

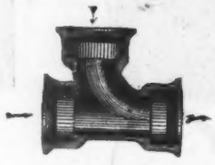


FIG. 24.

throw any pipes violently on the ground, nor to expose unloaded pipes to violent accidental blows. Owing to the brittleness of the material, cast-iron pipes often split or break off at the ends, and the split, although hardly perceptible on the outside, may continue longitudinally very far, which fact can only be detected by the pressure test,

In laying such cast-iron pipes, the spigot end of one pipe must be inserted as straight as possible and concentric into the hub end of the next pipe, care being taken before doing so that the pipe is clean and free from all dirt on its inside. A gasket of oakum or dry hemp is then inserted into the space between socket and spigot, and well rammed with a caulking

a. b. c.

FIG. 25.

tool. This gasket should fill about one-half of the depth of the hub, its object being to prevent any molten lead from flowing into the pipe at the joint, also to assist in tightening the joint.

A roll of good tough clay is placed around and pressed against the front of the pipe bell with an opening on top, where the two ends of the clay roll meet, large enough to admit of pouring in the lead. This clay ring prevents the escape of molten lead while running the joint.

The lead used for making pipe-joints should be soft and pure, without any admixture of tin, zinc or other metal. If hard or impure lead is used, the caulking operation strains the bells often so much as to burst or split them. The lead is melted in a large pot, kept on a furnace, It should be kept at a proper temperature in order to prevent too sudden cooling while pouring it. A large ladle (Fig 12), which must be capable of holding enough molten lead for one joint, is used to pour the lead into the

a. b. c. d. e. f. g. h.

FIG. 26.

space between spigot and bell. It is important that enough molten lead is poured in at one operation to quite fill the joint, for if the lead is not poured in a continuous stream the joint will not be perfect and homogeneous.

As soon as the socket is quite filled, the ring of clay can be removed and the lead allowed to cool, while the superfluous lead is cut off with a cold chisel. The lead naturally shrinks and would not, *per se*, make a tight joint, but requires a thorough setting up or caulking, which is done first with a hammer and flat calking tool, next with a similar broader tool, with a slight curve corresponding to the size or radius of the pipe. Fig. 13 shows the caulking tools generally used.

Fig. 14 shows the calked joint in section, when finished. To insure a perfect joint the ring of lead should have an equal thickness all around. This thickness varies from 1/4 to 3/8 inch; the ring should have a depth of from 1 1/2 to 2 inches. The following table, showing the amount of lead required for a joint, may serve as a guide:

a. b. c. d. e.

FIG. 27.

DIAMETER OF PIPE.	WEIGHT OF LEAD IN LBS.	DEPTH OF LEAD IN INCHES.
2	2	1 1/2
3	2 3/4	1 5/8
4	4	1 3/4
5	5 1/2	1 7/8
6	7	2

The lead must be left exposed so as to show the marks of the caulking tools. No paint, cement or putty should be used to fill the space in front of the caulking ring.

A proper caulking operation always puts a heavy strain on the sockets of the cast-iron pipe, and, in order to withstand it and prevent the bursting of bells, the latter should be designed very strong, with an extra thickness of metal at the end of the hub and at the point where the socket joins the pipe. The thickness of the hub should not be in direct propor-

a. b. c.

FIG. 28.

tion to the thickness of the pipe. This latter point is less thoroughly understood. The failure of common light plumbers' pipe is largely due to the fact that both the pipe shell and the thicknessof the bell are reduced to a minimum. See Fig. A. While it may be possible to reduce the former slightly, wherever there is no heavy inside pressure or outside superincumbent weight, the latter should always be kept heavy enough to withstand a thorough caulking. See FIG. B.

In making lead joints in cast-iron pipes much of course depends upon the skill, sound judgment, experience, but above all, upon the honesty of the workman. Careless or dishonest mechanics are very apt to do the caulking of the lead imperfectly, to omit this operation entirely at the under side of the joint, which is difficult of access, and not so readily inspected. Perfect workmanship is absolutely essential in the case of iron drain pipes, not less than for water or gas mains.

Cast-iron drain pipes require a number of fittings, such as elbows, Y branches, traps, Tee branches, which are also cast with bells and connected to the pipes in the same manner as lengths of pipe are put together."

All the fittings used in the Durham System are special cast-iron fittings, made by the Company for its own use only. All such castings are carefully examined before use. They must be sound, smooth especially on the inside, without lumps, sand-holes, flaws or other scoriæ. To quote from Baldwin Latham, C. E.

"There are faults, to which all articles made of cast-iron are liable, and which may escape observation even after the most careful scrutiny, and, in consequence, there will ever remain a certain degree of uncertainty as to the strength of iron castings, for there are numerous instances which may, more or less,

affect the quality of the manufactured article, such as unequaled contraction in cooling, imperfections from latent flaws which may be concealed by a covering of sound metal the brittle nature of the material, the presence of deleterious agent in the metal itself, all tending to render cast-iron more or less uncertain, and liable to fail without warning.

The proper admixture of the iron in the foundry is one of considerable importance in order to ensure a perfect casting; for, as different varieties of iron have different points of fusion and varying rates of cooling, unless a proper admixture is ensured, the casting will have within itself an element tending to produce its own destruction, for, while some of the metal may be in a perfect fusion, other parts may be imperfectly fused, while again others may be burned: or in cooling, some of the metals may cool faster or slower than others, consequently the casting may be thus brought into a state of unequal tension, or, as it is technically termed, 'hide-bound,' when such slight influences as sudden change of temperature may lead to its instant destruction."

All fittings for cast and wrought iron pipes are carefully protected from rust by heating them and then dipping them into a bath of liquid asphalt.

All fittings for cast-iron pipes have hubs of great strength, shaped as shown in Fig 15, allowing the perfect caulking of the leaded joints.

It is evident that wrought-iron pipe requires a larger variety of elbows and other fittings, as the screw joint does not allow of the least deviation, such as may be made in the lead caulked joint.

Common steam-fittings are unfit for purposes of house drainage, as they leave interior depressions, when the pipe is screwed up, which would collect sewage. (See Fig. 16a). The fittings for wrought-iron pipes in the Durham System are tapped with a shoulder (Fig. 16b), and when the wrought-iron pipe is screwed home, its interior and that of the fitting form a practically continuous line. All pipes, however do not screw up equally far, and it happens that occasionally a small recess remains between the end of the pipe and the shoulder of the fitting. Such recess will be too small to be of any harm, at any rate it cannot collect more sewage matter than the inevitable recesses in cast-iron pipe at the point where the spigot end should touch the inside of socket. With *tight* joints, it seems that no serious harm need be apprehended from such unavoidable imperfections.

The following is a condensed list showing the varieties of fittings manufactured for use with the Durham System, a few of these being shown in sketches. The total number of special fitting amounts to about 200.

1. *For cast-iron pipe, 3", 4" and 6" diameter:*

Running traps (Figs. 17 and 18), leader traps with deep water seal Fig. 19, and cellar-floor traps (Fig. 20).

90°, 60°, 45°, 22½°, 11¼°, 5⅝° ells, with one or two hubs. (Fig. 21).

Tee branches of all sizes. (Fig. 22).

Y branches, 45° (Fig. 23), all sizes, with or without hand-holes.

Y branches, 90° (Fig. 24), all sizes, with or without hand-holes.

Reducers of all sizes.

2. *For cast-iron pipe, with openings tapped for wrought-iron pipe.*

Soil pipe ells (Fig. 8 and Fig. 21h).

Sink ells, all sizes. (Fig. 21g).

Tees of all sizes. (Fig. 22c).

Cast and wrought-iron connection pieces or couplings. (See Fig. 25 *a*, *b*, *c*).

3. *For wrought-iron qipe, 2", 3", 4", 5" and 6" diameter:*

Plain ells, ells with ½" and with 1" grade, Three-way ells, 60°, 45°, 22½°, 11¼° and 5⅝° ells. (Fig. 26, *a*, *b*, *c*, *d*, *e*, *f*).

Water-closet ells (Fig. 26h), and water-closet flanges.

Plain Tees, graded Tees, all sizes (Fig. 27, *b*, *c*), water-closet Tees (Fig. 27a), crosses, with and without grade (Fig. 28a) increasers and reducers of all sizes, 45° and 67½° Y branches, in all sizes. (Fig. 27 *d* and *e*),

Water-closet traps (Fig. 29), yard drain traps, brushings, plugs, couplings, nipples, caps, union couplings and flange unions.

It has been repeatedly asserted that wrought-iron rusts quicker than cast-iron, if plain and entirely unprotected. This is true and well-known to every engineer, but it does not prevent engineers from using an otherwise excellent, and, in many respects and for many uses, superior material. All iron pipes used for sewerage purposes must be efficiently protected against corrosion, and such is done with cast-iron pipes by coating them with coal-tar pitch, while wrought-iron pipes are dipped thoroughly heated into hot asphalt. There seems to be no reason why such coating, if done with equal care, should wear off, when the pipe is in use, quicker from wrought-iron than from cast-iron pipes. It is a fact that all soil and waste pipes are coated after a little use with a peculiar, greasy slime, which tends to protect the pipe—a cast-iron as well as a wrought-iron pipe—against corrosion.

It occasionally happens in any system of soil or waste pipe that a length of pipe must be taken out and replaced, which can only be effected with plumbers' soil pipe by bursting a fitting. Such a result can also be attained in wrought-iron soil pipes by breaking a fitting; the new length can be inserted either by a flange-joint, or else by the use of a running thread and a lock-nut. It must be remembered that, in the case of plumber's soil pipe a heavy knock to break the pipe is likely to loosen many, if not all lead joints of the stack, while the screw-joints are not as easily effected.

It is true, to some extent, that cast-iron pipes are more easily and quickly cut for making connections without the necessity of great mechanical skill or any expensive tools. Wrought-iron pipes require heavy and costly stationary machines to which the pipe must be sent, or else slow-working and expensive hand-tools for cutting and threading. The lengths must be measured very accurately, and put together by skilled mechanics.

Some of the fittings for instance, Y branches for wrought-iron pipe are not so easily put in place on upright pipes in chaces, as the cast-iron fittings, but a skilled mechanic is generally able, with a little ingenuity, to overcome such difficulties.

AT THE meeting of Trustees last week, the contract for a fifteen-inch brick sewer in Ninety-second street, Hyde Park, Ills., was awarded at $3.23 per foot, to O'Donnell & Burns. The Clerk was instructed to return all bids for the construction of a sewer in Lake avenue, between Forty-third and Forty-seventh streets and re-advertise for bids. In reference to the drainage question, a proposition was read from George W. Waite and Joseph E. Young, to excavate a ditch six miles long for $50,000. The ditch should be thirty feet wide at the surface of the water, fifteen feet at the bottom with a depth of five feet, and an average slope of one and one-quarter foot, and should run from Commercial avenue, South Chicago, west on Eighty-seventh street to South Park avenue extended, thence north to Sixty-sixth street, the south line of the Washington Club Park. The proposition was referred to the Drainage Committee. Bids for laying water pipes in Sixty-third street and Oglesby avenue were opened and referred, the lowest for a six-inch pipe being $1.15 per foot and $63.80 per ton, and for an eight-inch $1.40 per foot and $61 per ton. The board adjourned to meet on Tuesday last, when the special order of business will be the consideration of the construction of a ship canal between Calumet River at Cummings and Calumet Lake.

SELECTED MISCELLANY.

THE discovery of tin at King's Mountain, Cleveland County, N. C., has been announced. This is the first discovery of this valuable mineral in the United States. The State chemist will make a careful examination.

DAVID WILLIAMS, of Slatington, Pa., has refused an offer of $100,000 cash for his slate quarry. He considers it worth to him $200,000. Last year he mined out 1,261,680 noiseless slates for Kane & Co., of Chicago, and the firm want him to double his capacity this year. During last year there were shipped from Portland 17,966 cases of school slate, or 3,233,800 slates.

IT is claimed that $10,000 has been spent at Ticonderoga, N. Y., in arranging for melting iron by a new process devised by a French inventor. The iron, instead of being melted and run into pigs, is heated to what is called a sponge-heat, and all impurities are then extracted, leaving the refined product so soft that it may be cut with a knife. It is said that by this new process a saving of $24 a ton is affected.

THE elevated railroads in New York have caused an increase of troublesome inflammation of the eyes. Flying chips of steel and iron from the rails and wheels of the cars enter the eyes without at once being noticed. Soon the eyes feel dry and hot and later the oculist's services are required. Another cause of trouble is reading in the cars. The light changes rapidly and unconsciously the eyes are injured. This trouble from reading is not confined to the elevated railroads, and yet it is indulged in by horse car and railroad travelers in full knowledge of the results.

MR. CHARLES ASHBURNER, of the Geological Survey of Pennsylvania, does not confine his work to the explanation of the difficulties in the geological structures of the coal beds, but considers the economical questions involved in mining operations. This is an important matter when it is remembered that in the coal fields between Mauch Chunk and Tamaqua, since mining commenced in 1820, only 27 per cent. of the actual amount of coal contained in the ground has been obtained as fuel, 41 per cent. having been left in the mines for support and 32 per cent. thrown on the dirt bank. It is gratifying therefore to learn that the improvements in mining have been such that in this same area 46 per cent. is now obtained as fuel, only 30 per cent. left in the mines and 24 per cent. deposited on the dirt bank as too fine and too dirty to burn.

There is no such body of anthracite coal in the world as is possessed by Pennsylvania, and a survey which is attaining such valuable and practical results should be pushed by the State Legislature until its ultimate completion.

RECENT experiments in illuminating railway trains in the United Kingdom with the incandescent electric lamp have proved very successful. So much so has this been the case that the one company on which the new light was tried (the London, Brighton and South Coast) will use the system to the exclusion of all others. The *Daily News* says the system employed is a combination of dynamo machines and accumulators. When the train was in motion the electricity was stored and given out as required. Thirty twenty-candle incandescent lamps were used. The apparatus was entirely under the control of the "front guard," who, by means of a handle, turned the current on and off at pleasure. For example, while the train was running in broad daylight the electric light was not used, but the moment a tunnel was entered it was employed to great advantage. The electricity was generated by means of a belt connecting the dynamo machine with the axle of one of the wheels. The system is the invention of Mr. Stroudley, of Brighton, (locomotive department), and Mr. Edward Houghton, the Superintendent of the telegraph department. It is said to be "much cheaper than gas and only a trifle dearer than oil."

PROF. H. F. WALLING, of the United States geological survey has nearly finished a topographical survey of Pittsfield county, Mass., on which he has been working most of the time for six months. He has established some 20 new points in the county and re-measured the height of Greylock, Perry's peak, Potter mountain and many other points, both by the use of the barometer and by vertical triangle. His measurements substantially agree with those formerly made. He has recently been devoting himself to the preliminary work on the new map in his office in the insurance building and will go to Washington in a few days where he can work to better advantage. Mr. Walling says this new geological work will be very elaborate when completed and will give in detail the height of land and its geological structure in the various states. The map he is constructing of the State will be on a scale of two inches to the mile and very accurate. The geological and mineralogical parts of the work will be done by different professors. Professors Charles Hitchcock of Dartmouth, Emerson of Amherst and Crosby of Boston will do the greater part of the work. They already have begun and will give as much time to the work as possible with their other duties. Prof. Walling has found many interesting features in the county which will appear in the government work.

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AND

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THE table of contents for volume ten will be mailed to subscribers next week. It has been impossible to get it out any sooner.

CLEEMANN'S Railroad Engineers' Practice will be ready for delivery early next week. All orders now in hand will be filled as rapidly as possible.

REFERRING to *The Topographer*, Prof. J. P. Lesley State Geologist of Penn'a., and probably the most eminent topographer in the country writes Mr. Haupt, "accept not only my thanks for so valuable a hand book for my table, but my congratulations on its certain success among field workers. Such a book was greatly needed and will be hailed with acclamation."

Chas. A. Ashburner, Geologist in charge, Anthracite District, 2d Geol. Survey of Penn'a. writes to the author. "The book supplies a great want to the profession. You have certainly treated the subject of your work in a clear, concise and complete manner, and it only remains for the topographer to apply practically in the field all the principles of his work which you have so satisfactorily explained. I know of no better treatise to guide the student and I am sure the experienced topographer will find it an invaluable hand-book."

A Tunnel Through the Pyrenees.

An international commission has been appointed, according to the *Moniteur Industrial*, to study the question of driving a tunnel through the Pyrenees, upon the territory of Canfran.

This commission, partly French and partly Spaniards, has commenced its labors, and was to arrange a definite report on Jan. 15. If, as there is reason to believe, the conclusions of this report are admitted, the two governments interested will immediately sign articles for the inauguration of work.

Tunneling Broadway, New York.

The Hon. Wm. J. McAlpine, Chief Engineer of the Broadway Underground Railway Co., has submitted to the Company a report upon the tunnels of London recently examined by him. He says that the underground railway there, known as the "Inner Circle," is a loop enclosing seven square miles in the heart of the metropolis, and is constructed beneath the foundations of buildings for more than two-thirds of its length; in one place supporting a monument, weighing 168 tons, upon the crown of the arch.

President Smith of the company, is in favor of building the arcade railway instead of a tunnel under Broadway; he says the absence of main sewers in lower Broadway and the easy grades make the work a simple one compared to similar work abroad.

Report of the Engineer Department of the District of Columbia.

The annual report of this Department has been issued for the year ending June 30, 1883. Major Garrett J. Lydecker, U. S. Eng. is Engineer Commissioner, assisted by Capts. R. L. Hoxie and F. V. Greene, Corps of Engineers U. S. A.

The water supply is first taken up. Waste has been checked to a considerable extent by a rigid system of inspection. The report shows that with 21,110 water takers there was a consumption of 24,314,715 gallons in twenty-four hours. Works for bringing an increased supply to the high grounds are now under contract.

As an alternative line of water supply to the present aqueduct upon which the city now alone depends, the valley of Rock Creek is recommended. A reservoir can be constructed at this point storing the rainfall over 45 square miles, and with a capacity in the driest season of 26,000,000 per day, at an elevation equal to the present pressure upon the mains. A map showing the location of this storage basin, as proposed, accompanies the report. The total cost of this basin, including land, damage is estimated at $950,000.

Work upon the district sewers has been slow and interrupted by limited appropriations and legal questions. Where pipe sewers have been down for some years they have been found to be more or less obstructed by the roots of trees, in some instances quite filled up. It is feared that a very considerable expense must be incurred on this account; all pipe sewers are now laid on a concrete bed in cement mortar, and the concrete carried up the sides and rammed hard between the pipes and sides of the excavation; the top of the joint is also sealed with cement. This treatment prevents the settlement and opening of the joints which allowed root penetration as mentioned above. A set of diagrams showing the shape and sizes of sewers constructed and proposed in the District from 1874 to 1883 accompanies the report.

Capt. F. V. Greene in his report upon the streets and roads of the District, states that $608,187.95 has been expended in the fiscal year ending June 30, 1883, and for the year 1883-84 $642,380, is appropriated, and he estimates that $647,500 will be required for the year 1884-85. There are now 3,420,187 sq. yards, or 137,94 miles of improved streets in the District, and 1,708,856, or 92.18 miles of unimproved streets. The replacement of worthless wooden pavements has continued to be the principal work of this department. In the appendix to the report are complete specifications for the laying out of standard pavements now in use in Washington (these specifications are published in full in ENGINEERING NEWS of March 10, 1883).

The regulation of the railroads entering Washington is still an unsettled question, though temporary relief has been obtained by certain concessions and agreements between the city and the companies.

In referring to the telegraph poles and wires, Capt. Greene says this nuisance has more than doubled in the last three years. There are now 2,623 poles, 79 miles of line, and 767 miles of wire in the city not including the house-top lines, which would probably add 150 miles more. After reciting the conditions upon which a number of these new lines were constructed and referring to the efforts, commenced in 1880, to put these lines under ground, Capt. Greene says that two applications from underground companies have been granted, one to the Standard Underground Cable Company, a company which manufactures cables only, and is not a telegraph company; the second is to be the Postal Telegraph Co., who have the exclusive right to construct conduits for electrical wires on 14th and "T" streets, provided other companies can lay their wires therein at a fair rental. The conduits of the latter company are constructed of brick masonry 16 in. square in cross section with a stone or iron cover, in which the cables lays. Their utility had not yet been tested when this report was made.

G. J. DeSmedt, Chemist and General Inspector of Cements, etc., has an interesting report upon the process of Portland cement manufactured and invented by him, which he calls the American Standard Portland cement.

A Project to Supply Lower New York with Water from Jersey City.

A committee of citizens and officials, appointed by the Mayor of Jersey City met on Jan. 25, to consider the proposed scheme of supplying lower New York with water. W. W. C. Sites, Chief Engineer of Jersey City gave the following outline of supply: He contemplated furnishing 30,000,000 gallons per day under a head of 137 ft. at high water, using 48 and 36 in. mains from the Belleville reservoir, and by a submerged main under the Hudson river. Four 15,000,000 gal's. pumps and a settling reservoir of 150,000,000 gal's. capacity would be required in addition to the mains. The estimated total cost of the scheme was $2,072,305. With a price of 70 cents per 1,000 gal's. the estimated annual revenue was $1,022,000; at 60 cents it would be $876,000; and at 50 cents $730,000. The annual operating cost is put down at $223,550.

Mr. Andrew Clerk, of the State Board of Water Commissioners, threw cold water on the project, by declaring that the amount of water required was not available from the Passaic river. The minimum capacity of that stream was about 125,000,000 gal's.; of this Paterson required 45,000,000; Jersey City, 17,600,000 and Newark, 10,500,000. The demand from all these cities would naturally increase, making storage dams at a great outlay necessary in the near future. The sewerage of Newark would also be a very objectionable feature to New York water consumers. To get the scheme proposed into operation would require two years time, and as New York would have an ample supply of her own with, that period, Mr. Clerk thought the whole project inadvisable.

The Mayor is to appoint a committee of one from each district to make full enquiry into the subject and report at a subsequent meeting.

Report of the R. R. Commissioners of Connecticut.

The 31st Annual Report of the Railroad Commissioners of Connecticut has been issued, covering the operations of railroads in that State for the year 1883.

Referring to the position of Connecticut as a territory which has for years tempted the constructors and projectors of rival lines between New York and Boston, the Commissioners mention the bitter contest of last year between the N. Y. & Conn. Air Line Railway and the Hartford & Harlem R. R. The first filed its articles of association on Oct. 22, 1881, but manifested little activity until the 30th of Dec., 1882, when the latter road filed articles covering practically the same ground between Greenwich and New Haven. The two companies are still battling for their respective claims before the R. R. Commissioners.

The N. Y. & Boston Inland R. R. Co. was associated on Feb. 4, 1882, with a capital stock of $10,000,000, to build from Boston to New York. The Commissioners have not yet been called upon to approve any located line, and unless 10 per cent. of its subscribed capital is expended before Feb. 4, 1884, its corporate existence expires.

The above taken with the newspaper reports of the intended application for a charter by a road to run from Mass. to Hartford, Conn., on the line of the Conn. Central, form the only new roads under consideration.

The general railroad law of Connecticut is claimed to be too liberal; unnecessarily subjecting the citizens to the caprice of two or three individuals. The Commissioners think it would be wise to put some restrictions, as has Massachusetts, upon the exercise of the right delegated by the Legislature to these individuals.

The theory of the existing law is, that when twenty-five persons subscribe ten to twenty per cent. of the cost of construction of a road, and pay in ten per cent. they can exercise the right of eminent domain, as required by public convenience and necessity. The practice of the law is, that one man who can find twenty-four others to associate with him, can furnish all the capital and exercise the same rights through a board of direction selected by him This practice exposes the public to the risk of being inconvenienced by the judgment of one man as to the public necessity of the work, instead of the combined judgment of twenty-five men, as intended.

The gross earnings of the various companies, as reported, show an increase of $881,286.40; amounting to $16,234,942.44, of which the passenger earnings were $7,041,937.02, and from freight, $8,005,510.07. The operating expenses have also increased by $1,551,587.36, being $11,890,389.57, or 73 per cent. of the gross earnings, which is 5 per cent. more than 1882. This increase is chiefly shown in the accounts of the N. Y. & N. E. R. R. and the N. Y. & New Haven R. R.

The number of miles of road operated by Conn., companies is 1,514,45, and the gross earnings per mile averages $10,934.86. The gross expenses per mile averages $7,957.56.

The gross earnings per mile run averaged $1.40 and the expenses per mile run, averaged $1.02.

The total train mileage was 11,616,477 miles, of which 5,848,310 was passenger mileage.

The average cost of maintenance of way per mile was $1,547.41, $147.66 less than last year.

The total number of passengers carried in 1883, was 16,352,617, an increase of six per cent. The freight carried amounted to 7,219,469 tons, an increase of nearly nine per cent. The receipts average 43 cents per passenger, and 1.95 cents per ton per mile for freight.

Existing highway grade crossings are reported at length in accordance with a resolution passed by the last Legislature, with recommendations in each case.

The adoption of standard time is recommended by the Commissioners.

PERSONAL.

Mr. A. R. TREW has been appointed Assistant Engineer of the Michigan Central Railroad Company in charge of Niagara River Bridge. Office at Suspension Bridge, N. Y.

THE Belgian Geographical Institute has dispatched Dr. JOSEPH CHAVANNE, of Vienna, to Central Africa to prepare a map of Congo country.

Mr. A. B. ROGERS, chief engineer of the C. P. R. in the Rockies, at present in St. Paul, was, upon the adoption of his report on the Kicking Horse Pass, presented by the company with a purse containing $5,000.

THE Minneapolis Engineers' Club elected the following officers for the ensuing year: President, William De la Barre; vice-president, George Cooley; secretary and treasurer, Prof. Parker; librarian, C. O. Foss.

THE Western Society of Engineers have elected officers as follows: President, D. C. Cregier; secretary, L. P. Morehouse; treasurer, Charles Fitz Simons; librarian, G. A. M. Liljencrantz.

ADOLPH BERNDES, a Swedish civil engineer age 26, shot himself through the temple last Wednesday, at St. Louis, Mo., while deranged by business troubles. He was unmaried. He came there from Stockholm.

MR. D, M. WHEELER, formerly connected with the St. Louis & San Francisco, has been appointed assistant engineer of the Burlington, Cedar Rapids & Northern R. R.

MR, W. W. RICH, formerly chief engineer of the Minnesota Central, has been appointed to a similar position on the Minneapolis, Sault Ste Marie & Atlantic R. R.

MR. O. H. HOFFMAN has been appointed chief engineer of the Minnesota Central (operated by Minneapolis & St. Louis R. R. vice Mr. W. W. Rich, resigned.

THE following changes have been announced in the Panama R. R. J. J. Yribe general superintendent in place of H. A. Woods resigned; A. C. Walker, chief engineer; S. W. Plume, assistant engineer and roadmaster in place of Charles E. Spaulding, deceased.

MAJOR S. WHINERY, engineer in charge of the northern division of the N. O. & N. E. R. R. was lately presented with an elegant service of solid silver valued at $337. The donors were members of his engineering staff and other friends, who in this way testified their appreciation of the affable qualities of the Major, and their regret at the separation about to take place.

Mr. CLARENCE PULLEN, a civil engineer of extended and favorable reputation, has during the past six years, been instrumental in effecting the greatest public improvements in New Mexico. His last work was the building and organizing of the sanitarium at the Las Vegas Hot Springs, which is admitted to be a masterpiece of engineering skill and administrative ability. His apointment as Surveyor General of New Mexico would be generally acceptable to all classes in that Territory.

THE department known as "Maintenance of Way" of the New York and New England Railway is abolished, and Mr. FRANCIS L. HILLS, who has for some years been engineer of the same, retires. Last week a very handsome solid silver pitcher was presented to him, bearing the following inscription: "Presented to Francis L. Hills, Engineer of Maintenance of Way of the N. Y. & N. E. R. R. by his subordinate officers and section foremen, in appreciation of his ability as an engineer; his uniform kindness as a man; and with best wishes for his future happiness and prosperity."

Mr. JAMES ROSS, Manager of Construction of the Canadian Pacific Railway, with headquarters at Winnipeg, Manitoba, is in this city at present arranging for work on the C. P. R. R. for the coming season. Mr. Ross is engaging civil engineers to form his companies about April 1st; first-class men for responsible positions will only be chosen. There will be a great deal of tunneling to be done and engineers familiar with that class of practice are in demand. Although most of the supplies will go from Montreal, yet in explosives, drills, etc., considerable purchases are made in New York. The C. P. R. R. Co., intend putting on a large force of men in the spring with the purpose of pushing the construction through the mountains as rapidly as possible. There are about 300 miles—all mountain work—necessary to complete Mr. Ross' division. Mr. Ross is to be addressed at Winnipeg. He left New York yesterday (Friday) to spend a week in Toronto, Canada.

OBITUARY.

JOHN AVERY, of the Public Works Department of this city, but who lived at Yonkers, started from his residence at a little before 9 o'clock Wednesday morning to walk down the tracks to the New York Central and Hudson River Railroad to Ludlow station to take a train to the city. The distance to be traversed was about a quarter of a mile and the morning was very foggy. He had gone but a little way when he met an up freight train, and he stepped on the down track. At the same instant the Poughkeepsie special, due in New York at 9:20, struck him and he fell under the locomotive, where his body was all cut up and strewed along the track for several hundred feet. The engineer of the Poughkeepsie special did not know that he had struck any one until he was looking over his engine at the Grand Central Station and found it besmeared with blood. The fireman on whose side Mr. Avery must have been struck, thought they had run over a dog at Ludlow, but the fog was so thick he could not say positively.

Mr. Avery was Assistant Engineer of the Sewer Bureau of the Department of Public Works, having been in the employment of the city for 24 years. His grandfather was private secretary to John Hancock, of Revolutionary fame. After being graduated from Harvard at an early age, he devoted himself to civil engineering. He was for a time First Assistant Engineer in the Lowell Water-works, and afterwards he held a similar position during the construction of the Brooklyn Water-works. He was also for a short time Chief Engineer of the New York, New Haven and Hartford Railroad, and since then he has been employed in the Public Works Department of this city. Under his superintendence a complete survey of the sewers has been made. He was one of the oldest members of the American Society of Civil Engineers, and at one time was President of the Bloomingdale Park Association, which owns a large reserve in Pike County, Penn. Among those who knew him best he was esteemed a thorough and trustworthy engineer, and socially he was a genial and pleasant gentleman. He was 54 years of age and leaves a widow and two children.

DR. ELISHA HARRIS, member and honorary secretary of the N. Y. State Board of Health, died at the Delavan House, Albany, on Jan. 31.

Mr. Harris was born in the East Parish of Westminster, Vermont, March 5, 1824, he studied at the University of New York and graduated in 1849 at the College of Physicians and Surgeons, N. Y.

During the civil war he was for five years a sanitary commissioner, being the first to suggest a sanitary commission. In 1875 he superintended a sanitary survey of New York city. From 1866 to 1870 he was Register of Vital Statistics and Sanitary Superintendent of New York city. In 1880, upon the erection of the N. Y. State Board of Health, Dr. Harris became one of the three commissioners, and remained in that office until his death. He was the author of many works upon sanitary and medical subjects.

A Method of Computing the Absolute Maximum Bending Moment on Stringers, Due to the Passage Across them of a Series of Concentrated Moving Loads.

Written for Engineering News:

BY J. C. BLAND, C. E.

From an analytical consideration of the effects produced on the stringers of railway bridges by the passage across them of a series of concentrated weights, such as the wheels of a locomotive, the following principles are found to flow:

1. That the maximum bending moment always occurs *under* a load.

2. That the maximum bending moment occurs under one or the other of the two loads, between which the resultant of the total number of loads considered passes.

3. That if the resultants of the total number of loads considered passes through a load, the maximum bending moment occurs under that load.

4. Calling the load under which the maximum bending moment occurs, the *critical* load, and x its distance from the left support, then when the *critical* load is in the position causing the maximum bending moment, its distance from the left support is less than the half-span, if the resultant of the total number of loads considered lies to the right of the *critical* load; and greater than the half-span, if the resultant lies to the left.

5. Calling Z the distance from the resultant of the total number of loads considered to the load on the right, and Δ the distance apart of the two loads between which the resultant passes, the distance of the load on the left from such resultant is $\Delta - Z$.

$$\text{Then } x = \frac{l}{2} + \frac{Z}{2} \text{ or, } x = \frac{l}{2} - \frac{\Delta - Z}{2}$$

according as the *critical* load is on the right or the left of such resultant.

6. That when the *critical* load is in the position causing the maximum bending moment, the centre of the span divides *equally* the distance between the resultant and the *critical* load, or in other words, the *critical* load and the resultant of the total number of loads considered are symmetrically placed with reference to the centre of the span.

7. That the expression for the maximum bending moment can always be put in one or the other of the two forms. *(a).* If the *critical* load lies to the right of the resultant of the total number of loads considered

$$M_0 = \frac{\Sigma . P}{4}\left[l + \frac{Z^2}{l} - 2\left(\frac{\Sigma . Pd}{\Sigma . P}\right)\right] \quad [1]$$

(b). If the *critical* load lies to the left of the resultant of the total number of loads considered

$$M_0 = \frac{\Sigma . P}{4}\left[l + \frac{(\Delta - Z)^2}{l} - 2\left(\frac{\Sigma . Pd}{\Sigma . P}\right)\right] \quad [2]$$

where $\Sigma . P \equiv$ number of loads on span, expressed in terms of the load on each pair of drivers. For example, if there are loads on the span of less moment than those on the drivers, express them in terms of the driver load. Thus the four pairs of drivers and the first pair of tender wheels being on the span, express the tender wheel load as ϑP, whence the total number of loads, $\Sigma . P = 4P + \vartheta P = (4+\vartheta) P$.

$l \equiv$ span

$Z \equiv$ as already defined in 5

$\Delta - Z \equiv$ as already defined in 5

$\Sigma . Pd \equiv$ sum of the moments of loads on span around the *critical* load as origin, *no regard being had as to sign*, that is, no regard being had to the *sense* of the moments.

8. That the expression for Z and for $\Delta - Z$ can always be put in the form

$$\frac{\Sigma^1 . Pd}{\Sigma . P} \quad [3]$$

where $\Sigma^1 . Pd \equiv$ summation of the moments of loads on the span around the *critical* load as origin, *regard being had to sign*, that is, regard being had to the *sense* of the moments.

9. Whence the maximum bending moment is *always* given by the following general expression: $M_0 =$

$$\frac{\Sigma . P}{4}\left\{ l + \left[\frac{\Sigma^1 . Pd}{\Sigma . P}\right] \cdot \frac{1}{l} - 2\left(\frac{\Sigma . Pd}{\Sigma . P}\right)\right\} \quad [4]$$

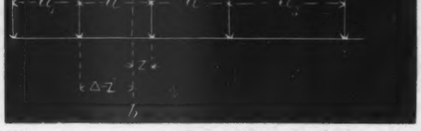
which can be used instead of equations [1] and [2].

10. That is, the cases where the resultant of the total number of loads considered passes between two of the loads, the maximum bending occurring under one or the other of these two loads, then in whichever of the expressions for M_0, considering first one and then the other as the *critical* load, the term

$$\left\{ \left[\frac{\Sigma^1 . Pd}{\Sigma . P}\right]^2 \cdot \frac{1}{l} - 2\left(\frac{\Sigma . Pd}{\Sigma . P}\right)\right\}$$

is the greater, that one gives the *absolute* maximum bending moment due to the passage of number of loads considered across the span.

For example, consider the "Erie" Consolidation Engine, in the case where 5 loads are on the span, viz: the four drivers and the first pair of tender wheels.



Where $P_1 = P_2 = P_3 = P_4$, hence call $P. = 11.0$ tons. $P_5 = 7.26$ tons $= \vartheta P$

Whence $\vartheta = \frac{7.26}{11.00} = 0.66$

$d = 4.5$ feet, $d_1 = 5.75$ feet, $d_3 = 7.083$ feet.

From these values it is found that the line of action of the resultant of these loads passes between P_2 and $_3$, whence by 2°, the maximum bending moment will occur under the loads P_2 or P_3. Let us first consider P_3 as the *critical* load, and apply our equation [4].

Then, $\Sigma . P = 4P + \vartheta P = (4+\vartheta) P. = 4.66 P.$

Taking moments of loads around P_3 as an origin, we have on the right of P_3,

$$P_4 d + P_5 (d + d_3) = P\left\{ d + \vartheta (d + d_3)\right\},$$

on the left of P_3,

$$P_2 d + P_1 (d + d_1) = P\left\{ 2d + d_1\right\}.$$

now counting moments whose tendency is opposite to the hands of a watch as positive, and those whose tendency is same as the hands of a watch as negative, then the moments on the left of P_3 are positive and those on the right of P_3 are negative, whence

$$\Sigma^1 . Pd = P\left\{ 2d + d_1 - \left[d + \vartheta (d + d_3)\right]\right\}$$

$$= P\left\{ d + d_1 - \vartheta (d + d_3)\right\}.$$

also, as $\Sigma . Pd$ is sum of moments without regard to the sign, we have

$$\Sigma . Pd = P\left\{ 2d + d_1 + d + \vartheta (d + d_3)\right\}$$

$$= P\left\{ 3d + d_1 + \vartheta (d + d_3)\right\}$$

$$\text{Then } \frac{\Sigma^1 . Pd}{\Sigma . P} = \frac{d + d_1 - \vartheta (d + d_3)}{4 + \vartheta}.$$

$$\text{and } 2\left(\frac{\Sigma . Pd}{\Sigma . P}\right) = 2\left\{\frac{3d + d_1 + \vartheta (d + d_3)}{4 + \vartheta}\right\}$$

Substituting these values in equation [4] we get $M_0 =$

$$\frac{4+\vartheta}{4} P\left\{ l + \left[\frac{d + d_1 - \vartheta (d + d_3)}{4 + \vartheta}\right]^2 \cdot \frac{1}{l} - 2\left[\frac{3d + d_1 + \vartheta (d + d_3)}{4 + \vartheta}\right]\right\}$$

Inserting in the above the values given for the distances between loads, etc., we get

$$M_0 = \frac{4.66}{4} \times 11.0 \left\{ l + \frac{.559^2}{l} - 11.543 \right\}$$

$$= 12.815\left\{ l + \frac{.3125}{l} - 11.543\right\}$$

$$= 12.815\, l + \frac{4.005}{l} - 147.923$$

Now suppose our span is 30 feet, then $M_0 =$

$$12.815 \times 30 + \frac{4.005}{30} - 147.923 = 236.66 \text{ foot-tons.}$$

Let us now take another case at random, say the three pairs of drivers, P_1, P_2, P_3. The distance d_1 being generally greater than d, and the driver loads alike, it is evident the line of action of the resultant will pass between the loads P_1 and P_2. It is the case in the "Erie" engine, we are considering for illustrations. Let us take P_2 as the *critical* load. Then

$\Sigma . P = 3P.$

$\Sigma^1 Pd = P\,(d_1 - d).$

$\Sigma . Pd = P\,(d_1 + d).$

$$\text{Whence } \frac{\Sigma^1 . Pd}{\Sigma . P} = \frac{d_1 - d}{3}$$

$$\text{and } 2\left(\frac{\Sigma . Pd}{\Sigma . P}\right) = \frac{2}{3}(d_1 + d).$$

Whence

$$M_0 = \frac{3P}{4}\left\{ l + \left[\frac{d_1 - d}{3}\right]^2 \frac{1}{l} - \frac{2}{3}(d_1 + d)\right\}$$

Inserting the values given for the load, P, and the distances, d and d_1, we get

$$M_0 = \frac{3 \times 11}{4}\left\{ l + \frac{0.1736}{l} - 6.833\right\}$$

$$= 8.25\, l + \frac{1.432}{l} - 56.375$$

Now, suppose the span is 15 feet, then

$$M_0 = 8.25 \times 15 + \frac{1.432}{15} - 56.375 = 67.47 \text{ foot tons.}$$

If we had chosen the three driver loads, P_2, P_3, P_4, we see that the resultant passes through the load P_3, since the other two loads are equally distant, d from it, whence the *critical* load is P_3. Here then

$\Sigma P = 3P.$

$\Sigma^1 . Pd = P\,(d - d) = 0.$

$\Sigma . Pd = P\,(d + d) = 2Pd.$

$$\text{Whence } \frac{\Sigma^1 . Pd}{\Sigma . P} = 0 \text{ and } 2\left(\frac{\Sigma . Pd}{\Sigma . P}\right) = \frac{4}{3} d$$

$$\text{Whence } M_0 = \frac{3P}{4}\left\{ l - \frac{4}{3} d\right\}$$

Inserting the values for P and d, we get

$$M_0 = \frac{3 \times 11}{4}\left\{ l - 6\right\} = 8.25\, l - 49.5$$

Now suppose the span to be 15 feet, then

$$M_0 = 8.25 \times 15 - 49.5 = 74.25$$

In passing, we might notice that this choice of loads gives a greater result than the loads, P_1, P_2 P_3.

Let us now take the four drivers, P_1, P_2, P_3, P_4. It is readily seen that in usual cases the resultant of the four loads pass between the loads P_2 and P_3.

Let us take the load P_3 as the *critical* load, then we have

$\Sigma P = 4P.$

$\Sigma^1 . Pd = P\,(d + d + d_1) - Pd = P\,(d + d_1)$

$\Sigma . Pd = P\,(d + d + d_1) + Pd = P\,(3d + d_1)$

Whence

$$\frac{\Sigma^1 . Pd}{\Sigma . P} = \frac{d + d_1}{4}$$

$$\text{and } 2 . \left(\frac{\Sigma . Pd}{\Sigma . P}\right) = 2\left(\frac{3d + d_1}{4}\right) = \frac{3d + d_1}{2}$$

$$\text{Whence } M_0 = \frac{4P}{4}\left\{ l + \left[\frac{d + d_1}{4}\right]^2 \frac{1}{l} - \frac{3d + d_1}{2}\right\}$$

$$= P\left\{ l + \left[\frac{d + d_1}{4}\right]^2 \cdot \frac{1}{l} - \frac{3d + d_1}{2}\right\}$$

Inserting the values of P, d and d_1 for the "Erie" engine, we get

$$M_0 = 11\left\{ l + \frac{6.566}{l} - 9.625\right\}$$

$$= 11\, l + \frac{72.23}{l} - 105.875.$$

Suppose the span to be 21 feet, then

$$M_0 = 11 \times 21 + \frac{72.23}{21} - 105.875 = 128.56 \text{ foot tons.}$$

Let us now take P_2 as the *critical* load. We then get

$$\Sigma^1.\ Pd = Pd_1 - P\ (d+2d) = -\ P\ (3d - d_1 - d_1)$$

and

$$\Sigma.\ Pd = Pd_1 + P\ (d+2d) = P\ (3d + d_1)$$

whence

$$\frac{\Sigma^1.\ Pd}{\Sigma.\ P} = -\frac{3d-d_1}{4} \text{ and } 2\left[\frac{\Sigma.\ Pd}{\Sigma.\ P}\right] = \frac{3d+d_1}{2}$$

now

$$\left[\frac{\Sigma^1.\ Pd}{\Sigma.\ P}\right]^2 = \left[-\frac{3d-d_1}{4}\right]^2 = \left[\frac{3d-d_1}{4}\right]^2$$

whence

$$M_o = P\left\{ l + \left[\frac{3d-d_1}{4}\right]^2 \cdot \frac{1}{l} - \frac{3d+d_1}{2} \right\}$$

Inserting the values of P, d and d_1 for the "Erie" engine, we get

$$M_o = 11.0\left\{ l + \frac{3.754}{l} - 9.625 \right\}$$

$$= 11\,l + \frac{41.294}{l} - 105.875$$

Computing for a 21 feet span, we get

$$M_o = 11 \times 21 + \frac{41.294}{21} - 105.875 = 127.09 \text{ foot tons.}$$

It is noticed that this result is less than that given by choosing P_3 as the *critical* load.

Sufficient illustrations have been given to show how easy of application is the general expression [4].

When any number of loads are considered, the two loads between which the resultant passes can generally be determined by inspection—if not easily seen, the determination is readily found. Then apply the expression [4] first considering the load on one side, then the load on the other side of the resultant as the *critical* load. Whichever gives the greater value of M_o, is the expression to use in computing the bending moments for that number of loads within the limits of span, both superior and inferior. Considering any particular engine, a table can be calculated showing the bending moments and limits of span for one, two, three, four, five, etc., loads in succession. The complete mathematical discussion from which the above principles have been deduced, we purpose soon to publish.

In that paper is discussed in detail the expressions for maximum bending moment, maximum shear, span limits and conditions necessary for the existence of the expressions, for the several cases of one, two, three and any number of concentrated loads rolling across a span. Also, is given the equations which determine where one case ends and the other begins.

We have formed a table giving the expressions for maxima bending moments, shears and span limits, due to the "Erie" engine, considering all cases from one to five loads inclusive, that is to say, all cases possible of occurrence between zero and thirty-three feet.

A table has then been formed giving the numerical values for maxima bending moments and shears for spans from 3 to 33 feet, and also the "equivalent" uniformly distributed loads per lineal foot of track for both maxima bending moments and shears, which, by the by, is *greater* for the maxima shears than for maxima bending moments.

Decline in Railway Securities.

Since the assassination of President Garfield at the begi ning of July, 1881, railroad stocks and bonds have suffered an astonishing decline. Including only about half of the stocks alone that are listed on the New York Stock Exchange, the loss in price since that time has been about $6,00,000,000. Conkling and Platt have made some money, however. New York Central has declined $26,000,000 in value; Lake Shore nearly $20,000,000; Burlington and Quincy, $35,000,000; Union Pacific, $30,000,000; Denver, $31,000,000; Cleveland, Columbus, Cincinnati and Indianapolis, $5,000,000; the four Villard stocks, $65,000,000; Western Union Telegraph, $16,000,000; Louisville and Nashville, $16,000,000; Erie, $18,000,000; Texas & Pacific, $16,000,000; Central Pacific, $23,000,000. The average decline in these is about 30 per cent. of their par value. Other stocks listed on the Exchange have declined, on the whole, relatively about as much, for in the list above given are some of the soundest and best dividend payers in the country, as well as others that represent collapsed expectations.

The nominal value of all railroad stocks in the country is about three times that of the companies quoted, and the decline in value since July, 1881, has been probably not less than $1,000,000. In addition, these great corporations have a still larger amount of bonds outstanding, though the decline in these has not been, on the whole, as great. If it has been less than half as great—and this is apparently a safe estimate, judging from such securities as are quoted—the apparent loss in the valuation of securities within two years and a half has been over $1,500,000,000. The securities represent, too, an enormous earning power, and the railroad system is even now earning more than it has ever earned before.

The Modern Horse-Car.

"In 1831," said John Stephenson, the veteran builder of horse-cars, to a *Tribune* reporter, "I designed and built the first tram car of the first railroad for street service in this country or abroad. This car consisted of three separate compartments, each compartment holding ten persons, and being entered by separate doors on the side from a guard rail. Seats were provided on top of the car for thirty more persons, the car was very much like the English railroad coach, though it was set considerably lower. It was hauled by a team of horses, the conductor remaining outside on the rail, rain or shine. The company for which it was built was called the New York and Harlem Road, running from Prince street, on the Bowery, along the line of the present Fourth avenue to Yorkville and Harlem. Fourth avenue at that time had not been opened, but the line had been surveyed in 1810.

"The fare paid varied with the distance, being sixpence, or six and one-quarter cents, from Prince street to Fourteenth street, sixpence more to a point where Forty-second street now runs across Fourth avenue, sixpence more to Yorkville, and twenty-five cents to Harlem. These fares were paid in the silver of the old Spanish currency then prevalent. In time, through fare was reduced to eighteen pence, and then to twelve. But the road did not succeed. In 1837, after six years of construction, it temporarily gave way to steamcars. In 1845, however, it resumed working under its charter, which had not been given up—and which, by the way, is the charter under which the present Fourth avenue horse-car line is operated. In that year, 1845, the cars were remodeled nearly to their present style, the great feature being the adoption of end platforms and entrances. No other horse-car line was built till 1852, when at about the same time charters were granted for the Second, Third, Sixth and Eighth avenue lines. Outside of New York, in this country, Boston first adopted the system in 1856, Philadelphia following in 1857, after which it spread over the country. New Orleans, in 1861, was the first to adopt the small car, or, as it is called, the bobtail car. And I should like to say right here that out of the 428 horse-car lines now existing in the United States, 279 use the small cars only, the remaining 149 having the conductor cars.

"We come now to the introduction of the idea abroad. In 1860 George Francis Train started a line, for which I constructed the cars, in Birkenhead, opposite Liverpool, in England. Popular feeling was against the idea, however, and the line proved a poor affair. I believe it did not declare a dividend in twenty years. So intense was the popular prejudice in England at that time that the starting of a horse-car in London caused a riot, and the rails were torn up. Nor could an act of Parliament be obtained until as late as 1870 for the construction of other roads. Now lines are operated in the American style in most of the principal cities in Great Britain, our cars by their combination of lightness, durability, and comfort having won the day against English manufactures. In 1866 South America took up street railroad enterprises on a large scale, Brazil, Venezuela, Chili, Peru, Uruguay, Ecuador, Costa Rica, and the Argentine Republic all adopting them. And it may be stated in general that our shipments to-day are to the remote corners of the globe—to New Zealand, Australia, Java, India, Japan, the Cape of Good Hope and Port Elizabeth in South Africa, as well as to Canada, France, Belgium, Portugal, Austria, Holland, Germany, Russia, Sweden, Norway and England. The English cars, for which we have large orders, differ from American cars in having winding stairs at each end, by which to reach the seats on top of the cars. The fares, too, in an English car, are so much a mile, as is the case with most of the European lines. There are three other companies constructing horse-cars in this country, at Troy, St. Louis and Philadelphia. As an institution the system is peculiarly American, both in point of original construction and its development."—*Cincinnati Enquirer.*

Shaft Sinking Through Quicksand.

According to a late paper read by Mr. Ritson Wilson, of the North Staffordshire (England) Mining Institute, the following were some of the difficulties met with in sinking a shaft at Podmore Hall Colliery, and the manner of overcoming them:

The surface soil was only 2 ft. deep, then came 38 ft. of quicksand heavily charged with water. The external diameter of the shaft to be sunk was 18 ft. Cast-iron tubbing was used to pass the quicksand stratum; this tubbing was in segments, each 3 ft. in height and about 7 ft. long and 1 inch thick; they were connected by inside flanges with a bearing of 5 inches. All the vertical and horizontal seams were arranged to admit a 1½ inch filling of pitch pine, which was driven in for the purpose of securing a water-tight joint, the flanges being strengthened by internal ribs and brackets to resist the wedging strain. During the sinking process the segments were held together by bolts which were removed and their places supplied by pitch pine plugs as soon as the shaft cylinder had reached its final bearing.

The arrangement for sinking was as follows: Three complete rings of tubbing, or 9 ft. of it in height, were first bolted together and suspended by eight hanging screw-rods over the site of the shaft. As the excavation progressed, the rings were lowered by the screws. At a depth of 18 ft. below the surface, and with a flow of water into the cylinder, of 140 gallons per minute, the ground around the shaft gradually sunk, and added to the inrush of material caused by this action, was the inequality in density of the clay stratum struck. One side of the tubbing sank more freely than the other, and the hanging-rods, which were fastened to the lower ring, broke, and the shaft-lining went 8 in. out of line. In an attempt to bring the tubbing back to its proper position, it began to wrench and three segments were broken through. This twisting was stopped by driving sheeting out under the first flange, and the cracked segments mended by wrought-iron plates. Soon after starting again, three other "rings or segments" broke, and after mending these as before, the sinking of this cylinder was abandoned.

To proceed with the shaft, a smaller tubbing 16 ft. 3 in. in diameter was adopted, sliding inside the first, and the space between the two secured by concrete and wedges, after the level of the bottom of the first tubbing had again been reached. From that point the further sinking was continued by bolting the segments to the lower flange of the ring in place, until the shaft had gone 18 ft. below the sand stratum. The first 33 ft. of quicksand was passed in nine days; the maximum amount of water struck was 170 gallons per minute, which was disposed of by a pulsometer pump.

TUNNELLING UNDER DIFFICULTIES.

A curious narrative of difficult engineering comes to us from France. It appears that the railroad from Montauban to Brive being authorized to run a tunnel through the Mont des Cabanes, a distance of a mile and a half (814 metres), the workmen successfully pierced through all of the distance but eight metres (twenty-six feet) during the year 1881. The two years which have elapsed since that time have been occupied in ineffectual efforts to penetrate the small distance remaining: ineffectual on account of the constant deposits of moistened earth, a sort of red phosphate, which is renewed as fast as it is removed, though fifteen tons per hour have been taken away during the two years. The material appears inexhaustible, and engineers from different parts of Europe have, after careful inspection, given their opinion that the task of completing the tunnel is impossible. The pillars which are used for supporting the roof of the tunnel have to be constantly renewed, as they become twisted and bent from the heavy load upon them, this even being the case with the metallic columns. Several persons have been killed during the progress of the work and a large number injured. Altogether the title given to the work of "Le Tunnel Infernal" would not seem to be misplaced. The cost of removing the mud of the recalcitrant twenty-six metres has already amounted to 3,500,000 francs, and it is impossible to estimate anything as to the future of this melancholy enterprise.—*Telegram.*

CORRESPONDENCE.

EXCAVATOR WANTED.

Special Correspondence Engineering News.

ST. PAUL, Jan. 27, 1884.

EDITOR ENGINEERING NEWS.—I should like to have you inform me where I can get descriptive catalogues of the best Excavating Machine that will handle about 1,000 cu. yards per day in a sand and gravel cut 20 feet deep, and load it on small cars or carts.

Yours truly,
ENGINEER.

[Referred to the Builders of Excavators and Dredgers.—ED. ENG. NEWS.]

ALUMINUM FOR TAPES.

Special Correspondence Engineering News.

CITY ENGINEER'S OFFICE,
LEAVENWORTH KAS., Jan. 22, 1884.

EDITOR ENGINEERING NEWS.—I would like to inquire through the columns of your paper whether aluminum or some of its bronzes would not be a good material for metallic tapes. The steel tapes in common use are anything but suitable. A material that will not corrode is really needed. G. W. PEARSONS.

THE ANTIQUITY OF ASPHALT.

Special Correspondence Engineering News.

35 BROADWAY, N. Y., Jan. 29, 1884.

EDITOR ENGINEERING NEWS.—Referring to your late notice of M Léon Malo's paper (p. 19 *ante*) on Asphalt, in which he mentions the fact of asphalt having been used in the Tower of Babel, I find by the same authority that it was used in Noah's Ark, for we read in Genesis VIC: 14, "*et bitumine linies intrinsecus et extrinsecus.*" So that asphalt was used *before* the Deluge.

Yours truly,
F. H. BOORMAN.

THE SOUTH PENNSYLVANIA TUNNEL.

Special Correspondence Engineering News.

WILMINGTON, DEL., January 30, 1884.

EDITOR ENGINEERING NEWS:—The writer has just returned from an extended tour on the South Pennsylvania Railroad, and having gleaned the following points submits them to you for publication:

Messrs. McMahon, Shannahan & Green, contractors for the Roy's Hill tunnel on the South Pennsylvania Railroad, are now working in a section of the country that is wild in the extreme. Their camp has a weird appearance, and everything resembles greatly a western mining town. They have in commissary a stock of $6,000 and are patronized by the surrounding neighborhood, stores being many miles distant. There are employed at the east and west ends of the tunnel, 300 Italians and Hungarians, and one camp physician attends to their ailments. Shortly the force will be increased to about 400. The workmen are now building approaches to the tunnel on the ends but have not yet gotten under ground. As yet no solid rock has been encountered, the material being hard-pan and loose rock. The specified time for finishing the tunnel is 18 months, but unless the American Construction Company orders shafts to be sunk from the vertex of the various hills, two years will be consumed in its construction. Messrs. McMahan, Shannahan & Green have also been awarded the Petermas tunnel on the Baltimore & Ohio, Washington & Connellsville division, as well as several other sections on the same road. The above information was given your correspondent by Mr. D. A. Shannahan.

Messrs. O'Brien & Rodgers, contractors for the Sideling Hill tunnel, were called upon. They are stationed about 20 miles from any point of rail, and have about 400 men employed. Nothing but hard-pan and loose rock has been encountered on the east end, though the west end is more advanced. An Ingersoll compressor is on the ground but it has not yet been used. They will start under ground by next week, when all the apparatus will have arrived.

Messrs. Mason & Co., of the Tuscarora tunnel, have 125 men employed on the east end in construction of the approaches and are building quarters for men at the west end. It is likely they will put on a full force next month, and they are contemplating employing an Ingersoll Compressor, but have not yet decided between it and a Rand. They will employ the most improved appliances for tunnelling used, as the time for the completion of this work is limited. Mr. Rhinehardt, of Mason & Co., has been awarded a section about 8 miles approximately on the west end of the Tuscarora tunnel.

Your correspondent met Wm. Atwood, division engineer, having in charge Kittataning and Blue mountain tunnels, and after a roundabout drive of 15 miles over a wild country, Kittataning was reached, where Messrs. Evans & Ackerman have the contract for the above-named tunnel. They have employed at the east and west ends about 275 men and have an Ingersoll Compressor. Their engine is in position and they propose running a 4-inch iron pipe 5900 feet long over the mountain, which if done, will prove a feat in mechanical and civil engineering. The pipe will be carried over from the east to the west end and it is proposed to use it as a motor for propelling drills.

Mr. Patrick Keating, contractor for the Blue mountain tunnel, also anticipates the construction of a pipe line over the Blue mountain. His engine will be situated at the east end of the tunnel, and will supply compressed air for both ends of the tunnel. Mr. Keating has 200 men employed. A compressor has not yet been purchased, but he is most favorably impressed with the Rand. The machinery at this point will be in operation in two weeks.

Messrs. Patterson & Kuhn have been awarded the contract for Laurel Hill Tunnel.

Very respectfully, yours,
D. C. SPRUANCE,
With Chas. Warner & Co.

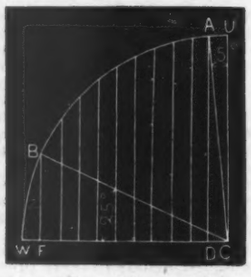
THE TOPOGRAPHER.

Special Correspondence Engineering News.

PHILADELPHIA, Jan. 28, 1884.

EDITOR ENGINEERING NEWS.—Replying to "G. R. G.," in your issue of this date, I would say (unless Prof. Haupt says it for himself,) that he (Prof. Haupt) has simply, through a very pardonable inadvertence, failed to make clear to the reader what must be perfectly clear to himself, viz: the fact of a difference between a degree of arc *of Polaris' apparent revolution about the poles*, and a degree of arc *our Azimuth*. Thus, as "G. R. G." says, in 5 h. 59 min.. during which Polaris passes through $\frac{23}{24}$° = 90° of its *daily revolution*, it can (when passing from culmination to elongation, or *visa versa*) traverse only about 1° 45′ of Azimuth, in latitude 41°.

Having had occasion, last October, on the circular invitation of the Society of Surveyors of "G. R. G's" good State of Ohio, to spend an hour or so of a chilly October morning, long before breakfast, watching for Polaris through thick scudding clouds, I have a fellow feeling for fellow amateurs, and I therefore feel moved to say, for their comfort, that, as will be seen by sketch below, an error of time of 20 minutes can at the most (when Polaris is at a culmination, or immediately above or below the pole) make a difference of only about 10 minutes of Azimuth; and that for smaller errors of time the error in Azimuth may, for our purposes, be taken in the same proportion of 1 minute of Azimuth for every 2 minutes of time.



Thus, in 20 minutes, or ⅓ hour, Polaris would pass over $\frac{360°}{24 \text{ hours}} \times \frac{1}{3} = 5°$ of its daily apparent revolution or from upper culmination, *U*, to *A*. This corresponds to *CD*, or to about one eleventh of the total difference, *CW*, of Azimuth* between culmination *U*, and elongation, *W*; or (for latitude 41°) $\frac{1° 45'}{11}$ = say 10′. Whereas to cover the *last* 10′ of Azimuth between *F* and *W* Polaris must pass over on arc, *BW*, of nearly 25° of its apparent revolution, requiring about 1 hour and 40 minutes. At this portion of its path it is no longer approximate to divide the error of Azimuth in proportion to the error in time. It is, no doubt, in view of this slightness of errors of time, when Polaris is near elongation that Prof. Haupt allows us to consider Polaris as being at elongation, when it and Alioth are "nearly" in a horizontal line. Respectfully,

JOHN C. TRAUTWINE, JR.

**C. W.*, of course, represents the *polar distance* of Polaris; but its Azimuth is divided in about the same proportion.

THE "TOPOGRAPHER."

Special Correspondence Engineering News.

PHILADELPHIA, Jan. 28, 1884.

EDITOR ENGINEERING NEWS.—In reply to the questions of your correspondent, G. R. G., of Homeworth, Ohio, permit me to say that his failure to understand Sec. 142 would appear to arise from his not distinguishing clearly between the apparent motion of Polaris in its own orbit and to which the term "arc" is intended to apply and the term "azimuth" which is the angle at the place of observation.

In his second query as to what the word "nearly" includes, his suppositions are correct. The author wishes it to be understood that the directions given in the ¶ referred to for determining the meridian were written for practical men who have not been able to avail themselves of a liberal education, and he has purposely avoided the use of unnecessary refinements, but aimed at securing a good practical result within the limits of accuracy necessary for ordinary land surveys.

In referring to the paragraph 142, the author has discovered a typographical error in the word "place," second line from bottom should read "plane." This may have misled your correspondent.

L. M. HAUPT.

Finding Deflections for Sub-Chords.

Special Correspondence Engineering News.

LEAVENWORTH, KAS., Jan. 22, 1884.

EDITOR ENGINEERING NEWS.—For the benefit of your correspondent, "A Subscriber," I give the following detailed explanation: One of the fundamental principles of running railroad curves is "the deflection for any chord is proportional to the length of the chord." The deflection for a chord of 100 ft. is one half the degree of the curve. To reduce this to minutes multiply by 60, or what is equivalent, multiply the degree of the curve by 30. The deflection for a chord one foot long would be this last sum divided by 100, or the degree of the curve multiplied by .3. For any other chord multiply the last result by the length of the chord. To state it algebraically:—

Let d = the degree of the curve,

Then $\frac{d}{2}$ = deflection for 100 ft. chord in degrees,

And $60\frac{d}{2} = 30\,d$ = deflection for 100 ft. chord in minutes

And $\frac{30d}{100} = \frac{3d}{10}$ = deflection for 1 ft. chord in minutes.

For a chord whose length is a, we have:—

$\frac{3}{10}\,ad$ = deflection in minutes.

"A Subscriber" should read the Railroad Surveyor's Primer with more care. See Shunk's "Field Engineer," Article XXI. F. A.

WATER DEPARTMENT,
ENGINEER'S OFFICE, 23 E. FIFTH ST.,
ST. PAUL, MINN., Jan. 23, 1884.

EDITOR ENGINEERING NEWS.—I submit the following in explanation to the question of "A Subscriber," relative to the deflection for sub-chords, contained in your issue of January 19.

Let D represent degree of curvature and L the length of the sub-chord in feet, then the deflection in minutes will equal $\frac{D \times L \times 60}{2 \times 100}$ which can be reduced to the simpler form that he mentions, $D \times L \times .3$.

Respectfully yours,
G. T. P.

NORRISTOWN, PA., Jan. 22, 1884.

EDITOR ENGINEERING NEWS.—"A Subscriber" from Richmond, Ky., wants to know the why and wherefore of 6°×.3×56ft. = 100′.8 = 1°40′.8; to the best of my knowledge and belief 6°×.3×56ft. = 100°.8 not 100′.8.

For a six (6) degree curve the deflection for 100 ft. is, of course, three (3) degrees, or in minutes, 3×60′ = 180′ or for one (1) ft. 3×.6′ = 1′.8, or again the deflection for one (1) ft. is plainly 6×.3′ not as "Subscriber" had it 6°×.3.

Very truly,
ANOTHER SUBSCRIBER.

BUFFALO, N. Y., Jan. 21, 1884.

EDITOR ENGINEERING NEWS.—The rule given by "A Subscriber" for finding deflection for a sub-chord is as easily explained as it is simple. Of course, for a full chord or station, the deflection is ⅓ the degree of curvature; and the deflection for a sub-chord or some part of a station is that many hundredths of the full deflection. The result is always in degrees and hundredths of a degree and must be multiplied by 60 to get minutes. With these words the following complete statement of the operation will be plain.

$$6° \times \frac{56'}{10} \times 3 = \frac{6° \times 56' \times 3}{10} \text{ or } 6° \times 56' \times .3 = 100.8' \text{ or } 1°\,40.8'$$

Thus the product of the degree of curvature by length of sub-chord, by the three tenths (.3) will always give the deflection in minutes.

CHAS. A. MIXER.

[We have answers, with same result, from a score of other correspondents, who will please excuse us if we omit to publish their methods, our space preventing.—ED. ENG. NEWS.]

PITTSBURG, PA., Jan. 25.—For several weeks past the County Commissioners have been busy examining plans for the new court-house. It is now understood they have accepted the plan submitted by Mr. Richardson, the Boston architect. He submitted with the plan a bona-fide offer to erect the building at a cost of $1,900,000, this being nearly a quarter of a million lower than any other offer. Mr. Richardson states that he can have matters in shape to receive bids for material and construction of the new building by the first of May, provided the contract is awarded him by the first of February. There are bids from New York, Philadelphia, Chicago, Pittsburg, and perhaps other places.

NEWS OF THE WEEK.

Streets, Drainage, Sewerage, Etc.

FORT SCOTT, Mo., is taking steps to provide the city with sewerage.

SANDUSKY, OHIO, Jan. 28.—Alfred Philby, of this city, went down in a manhole of the public sewer here this evening to clean it out and was suffocated by gas. He was 24 years old, and leaves a widow.

ADVOCATES of cedar block pavement in Minneapolis need not fear any reactionary influence from the petition of several hundred cab owners in Berlin, urging the laying of stone pavements exclusively, on account of the number of accidents happening on the noiseless wood and asphalt. In Minneapolis the rule in winter, as well as in summer, is to strew the pavements with sticks and slabs from overloaded wood carts and with cubes of limestone from wagons, in order that vehicles in passing along may sound a warning "kerchunk" every few yards to apprise people of their coming, and, so far, it has been successful—no accidents to people from noiseless pavements having been reported. Its beneficial effect upon the pavement and vehicles, however, is questioned.—*Minneapolis Tribune.*

"ONE of the most important measures I wish to introduce before the spring," said City Engineer Knight, of Kansas City, Mo., "will be an ordinance providing for the purchase of a steam roller. I endeavored to obtain one last year, and shall do so again. There is at present in this city a great and most unreasonable prejudice against macadamized roads, but as a matter of fact we do not know what proper macadam is. If we had a heavy roller, weighing from twelve to fifteen tons, and rolled our macadam roads with it before we allow any travel to pass over them, the result would be surprising, and would also have the effect of forming splendid traffic roads, which would not be rutted by heavy loads, as is apt to be the case at present. Such a roller would cost about $6,000, and would save its cost in a very short time. My idea would be to have the city purchase the roller and allow the contractors the free use of it, on their guarantee to defray any damage which it might receive while in their possession."

Contracting Miscellany.

THE contract for grading eighty miles of the Tower City road has been let to J. Voak & Co., of Fargo, and Foley Bros., of Minnesota.

LANCASTER, Jan. 30.—Hon. John T. MacGonigle, Mayor of Lancaster, the Water Committee of Councils and their clerk, and Jacob Holbach, Superintendent of the Water-Works, left Lancaster this morning for New York, where they will inspect the new 6,000,000-gallon steam Worthington pump which is being built for the city.

THE work of building a seawall and filling the flats on the Cambridge side of the Charles River was commenced in May last and prosecuted vigorously until the contractors were shut off by the ice. One thousand and thirteen feet of wall have been built, and some forty acres of land partially filled. The wall is twelve feet thick at the bottom, tapering to four feet at the top. After the ice has been cleared away work will be resumed, and it is expected more will be accomplished the coming season that last.

A WASHINGTON friend of the Nicaraguan Canal Company has received a letter from Managua, Nicaragua, written by a citizen of that country, in which "the failure of the canal project" is spoken of as a deplorable but recognized fact for the present, though the writer expresses hope for the future, believing that the canal will be built through some other instrumentality than that of the existing company. The concession from the Nicaraguan Government expires in September next, and requires a previous expenditure of $2,000,000 on the work to make it permanently valid.

JOLIET, Ill., Jan. 29.—The Jury in the suit brought here from Chicago of Sexton against The County of Cook, wherein Sexton sued the county for $165,000 balance claimed to be due, him on the Court house contract, gave Sexton a verdict of $135,500. The jury did not allow him the $30,000 claimed for interest and discount. The largest of the claims was for delays said to have been occasioned by the county between the letting of the contracts to Sexton and the execution of the same by him his point being that in this way he had been put to extra expense in the purchase of material and otherwise. This gave grounds for the modest demand of $136,000. Another suit was for $25,000, the amount of the alleged discount on country orders received by him for carrying on the work during the time when here was money in the treasury.

Water, Gas and Steam.

CHICAGO will require for its portion of improving the streets this year an appropriation of $600,000. It will also require an appropriation of $32,000 to finish up the street improvements left from last year.

READING, PA., Jan, 28.—The Mellert Iron Company's Pipe Mill closed to-day for the remainder of the winter, thus throwing 300 men out of employment. There is no lack of work, but the mill was stopped because the cold weather interfered with its workings.

GEO. H. PIERSON, Engineer for the Irvington, N. Y., Water-works, has been engaged by Dobbs' Ferry, N. Y., to prepare plans and specifications for water supply and sewerage, for that village, which work is proposed to be pushed to completion in early spring.

APPLICATION has been made for the incorporation of the Mamaroneck Water Company, with a capital of $25,000, for the purpose of supplying that place with water for fire and domestic purposes. The incorporators have purchased the Purdy mills on Mamaroneck river for a water supply.

IT is considered that it will be impossible for the contractors to complete the new water tunnel at Lynn, Mass., by the first of March, and the Water Board will probably extend the time for them. There are about 175 feet of the tunnel completed, and fifty men are employed on three of the headings. There is probably two months' work yet on the pipe.

FIFTY miles of lead piping for the Winnipeg & Northwest petroleum company is said to be now lying at Calgary. It is proposed to lay this pipe from Athabasca landing to the mouth of Sucker creek on the Saskatchewan, a distance of about sixty miles. It is intended to bring the crude oil by boat from the company's claim to Athabasca landing, refine it there and send the oil through the pipe to touch the navigation of the Saskatachewan.—*Bulletin*, December 29.

THE committee appointed upon the matter of the Nahant, Mass., water supply will submit a report with reference to the amount of pipe necessary to pipe the town, but makes as yet no suggestion as to a future source of supply. The tubular wells which have been sunk in Bear Meadow have not been a success. The committee have decided to supply all of the area included by the public streets, except Wharf street and parts of Bass Point. It is considered that 13,200 feet of 10-inch pipe. 11,750 feet of 6-inch, 21,200 feet of 4-inch, and 5750 feet of 2-inch pipe will be needed. R. D. Wood & Co., of Philadelphia, will supply the pipe. $133.40 per long ton, or for $20,500.

THE bids for 20 inch pipe as per proposals advertised in ENGINEERING NEWS, Jan. 5 and 12, were opened on Jan. 15, 1884, and were as follows:

Patent Water Pipe Co., 41 Dey street, New York, for wrought-iron, rejected.

J. B. Collins,	Only Laying,	Complete,	$ 9,825 00
Miles Tierney	"	"	10,384 00
A. H. McNeal	"	"	7,452 00
Hutchinson Bros.	"	"	7,344 00
Gloucester Iron W'ks	Pipe Deliv'd in Norfolk		$32.75 per ton
Mellert Foundry & Machine Co.	"	"	$33 00 per ton
R. B. Allen	"	"	27,123 50
Warren Foundry	"	"	$32 00 per ton
R. D. Wood & Co.,	"	"	24,408 00
Miles Tierney	Whole Work	Complete	39,420 00
A. J. Dalton,	"	"	35,640 00
John F. Ward,	"	"	49,000 00
R. D. Wood & Co.,	"	"	32,832 00
Hutchinson Bros.,	"	"	32,750 00

The contract was awarded R. D. Wood & Co., of Philadelphia, for the pipe, and to Hutchinson Bros., of Baltimore, Md., for the laying.

BUFFALO, N. Y., Jan. 28.—The annual report of the Water Commissioners of this city was made public to-day. It states that for the first time in their history the water-works may now be considered self-sustaining, and they are also in excellent condition. There has been a reduction in rates to domestic consumers during the past year of 33⅓ per cent., and a reduction to manufacturers from 9 cents to 3 cents per 1,000 gallons. The mains have been extended very considerably. The total expenses of running the works and of extensions for the year were $442,210. The Commissioners say: "We feel that the showing is good enough to warrant a concession in rates to domestic consumers of 10 per cent., 5 per cent. in May and 5 per cent. in November bills, and we do so recommend." The water debt has been reduced $10,000 during the year, leaving it $2,871,882. The Commissioners suggest that instead of paying the debt by drafts on the general fund the principal be refunded at a lower rate of interest as it becomes due until the surplus revenues are large enough to extinguish it. The use of the waterphone for detecting leaks and wastes has resulted in verifying the estimate that the loss of water is from 40 to 50 per cent. of all the water pumped.

PHILADELPHIA Councils have authorized the Chief Engineer to lay 200,000 feet of pipe, but have only appropriated money enough to lay 50,000 feet.

THE Committee on Water Supply of the Mass. Legislature gave a hearing last week on the petition of the city of Newton for authority to add $100,000 to its water debt, which is $950,000, for the purpose of procuring pipe which will be needed during the current year. City Solicitor Slocomb, and E. W. Cate, President of the Newton Water Board, presented the case, stating the needs of their municipality in this direction, and that it has a valuation of $30,000,000, with a total gross debt of about $1,330,000, and a net debt of but $265,894 59.

The committee also heard the petition of the town of Northboro' for authority to issue additional water bonds to the amount of $15,000, the amount now outstanding being $50,000. Mr. Silas Potter spoke for the petition, saying that the town has no debt.

The committee also had before it Mayor Keith of Brockton, who asked that that municipality may increase its water debt by the issue of $100,000 in bonds; its report on this matter was a bill embodying the request of the city.

Representatives Atkins and Roads and Messrs. A. C. Orne, H. R. Goodwin and W. P. Proctor asked that the town of Marblehead may take about ten acres of land, at an estimated cost of $7000, for the purpose of adding to the capacity of its reservoir.

The Committee on Public Health had under consideration the plea for legislation to prevent the pollution of streams used as sources of water supply. Hon. Wm. A. Simmons, President of the Boston Water Board, spoke of the need of general legislation on this subject, saying that although Boston is greatly interested, that city does not desire any special legislation. The sources of water supply throughout the State should be protected, and the time to provide for such protection is before more of them are defiled. City Solicitor Baily, of Boston, stated that the city of Boston is obliged only to take care of those impurities which affect its own sources of supply. Under the law of 1878, although the contrary effect was doubtless intended, protection from pollution is much more difficult than it was before that time, as the execution of that measure is in the hands of the State Board of Health, from which it is a matter of too long to get a remedy.

The committee having voted to limit the question to such cases of pollution as may be presented by a general law, Mr. Bailey resumed his argument. He said it was not a question of drainage, because factories and other establishments are sources of pollution, and that Boston, under the law, can only protect Lake Cochituate. Mr. J. B. Fairbanks of Natick, claimed that sufficient notice had not been given. This led to a debate, which was terminated by the decision of the committee to proceed. Then Dr. Charles F. Folson was called as the first of a series of witnesses, among whom were Dr. Wolcott, of the State Board of Health and Dr. Durgin, of the Boston Board of Health, who testified that a general law to prevent pollution of water used for domestic purposes is a matter of urgent necessity.

Railroads.

THE Pontiac & Pacific Junction Railway, starting from Ottawa to Lake Temiscaming, will be placed under contract at an early date.

THE contract to extend the Delaware & Hudson Railroad double track from the Geyser Spring, near Saratoga, to the station at Ballston, has been let.

MR. LEON, said to represent American interests, has submitted a proposition to the Porte for the construction of a ship-railway from El Arish, on the Mediterranean, to Akaba on the Red Sea.

IT is said by a special correspondent at Ottawa, that, although as yet not a mile of the proposed extension of the international Railway into Maine has been built, nearly all the $150,000 subsidy voted by Parliament has been paid over.

HARRISONBURG, VA., Jan. 28.—A corps of engineers of the New York Construction Company, A. P. Bovier, chief, arrived here to-day, and will on Wednesday begin the survey of a branch from the Shenandoah Valley Railroad to the West Virginia line. The work will be commenced at Harrisonburg and will be rapidly prosecuted.

THE Redfield, Bismarck & Northern Railway Company have received its charter. The company was formed for the purpose of building and operating a line of road from Bedfield, D. T., in a northwesterly direction to Bismark. The survey will be made as soon as the weather will permit, and the grading begun.

CONTINENTAL Divide International Railway.—This company which proposes to build a line from Alaska to Mexico, has filed articles of incorporation in Colorado. The capital stock is $200,000,000, and the incorporators are: Henry W. Johnson, Frank H. Harding, Elijah Keating and Timothy D. Glassman. The principal place of business of the company is San Francisco, and branch offices are to be located in Denver, Portland, Oregon and New York.

GROUND was broken at Bridgeport, Conn., Thursday, for the construction of the New York & Connecticut Air Line Old Parallel Railroad. Mr. H. R. Parrott, one of the prominent Directors of the enterprise, and who has been long and earnestly identified with the project, threw out the first shovelfull of gravel. The construction of the entire line is now under contract, and work will at once follow at six or eight points along the line, and will be pushed ahead as rapidly as possible.

THE trouble of the West Shore railroad have been lightened by a loan of $12,000,000 made by the Central Trust Company of this city. The loan is to be carried at 5 per cent., and will run for 50 years. Three-quarters of the amount will be applied to the completion of improvements already begun, and the balance to the acquisition of additional land, rolling stock and other equipments. The Trust Company is secured by all the property belonging to the West Shore road, and the loan will take the shape of bonds, registered and coupon, of whose sale the Central Trust Company will take charge.

THE Yankton, Okobjo & Ft. Buford company has been incorporated to build a railway from Yankton, in the southern part of Dakota, northerly along the east bank of the Missouri river to Ft. Buford, near the Montana line and about 70 miles south of the northern boundary of the United States. It also proposes a branch eastward along the Okobojo valley, which is said to be a very fertile region, and affording an extremely inexpensive route for railway. Mr. Wm. Ashley Jones, chairman of the executive committee, residing at Pierre, Dak., will give full information to any railway men desiring to interest themselves in this enterprise.

THE Central Pacific railroad company has furnished the bureau of labor statistics with a list of its employes, their occupation and compensation, as follows: Total number, 8,986 persons, comprising 436 clerks with salaries ranging from $50 to $200 a month; 225 agents from $50 to $225; 221 conductors from $85 to $115; 18 porters from $40 to $90; 4 mesengers from $20 to $35; 740 station laborers from $60 to $95; 704 brake and flagmen from $65 to $80; 3,452 laborers from $35 to $90; 3,388 receiving not more that $55; 60 pumpers from $65 to $85; 195 patrolmen from $41 to $55; 845 mechanics at $52 to $84; 143 engine wipers at $60.90; cleaners at $80; 287 steamer hands from $60 to $175; 19 in shipyards from $84 to $104; 304 engineers from $85 to $145; 388 firemen from $65 to $80; 12 draughtsmen from $75 to $200; 570 mechanics from $60 to $85; and 50 watchmen from $55 to $60.

A MEETING of prominent citizens of South Bend, Laporte and Valparaiso, Ind., was held at the Grand Pacific, Chicago, last week, for the purpose of forming a company to build a railroad from South Bend to the Illinois State line, where it would intersect the Indiana, Illinois & Iowa Railroad. The distance is about eighty miles, and the road is intended to follow as nearly as possible the valley of the Kankakee River. Its name will be the South Bend & Kankakee Valley Railroad Company. The building of the railroad is, however, a secondary consideration, and is merely incidental to the digging of a ditch along the same line, which is needed to drain the lands adjacent to the course of the river. The expense of digging this ditch will fall upon the property-holders along its line, but as the earth removed in excavation will form a natural railroad-bed, thereby saving half the expense usually incurred in grading a railway, it was thought a good scheme to form a company and build the road. About 45,000 acres of land was represented at the meeting, which was presided over by Mr. Clem. Studebaker. In order to form such a company according to the laws of Indiana, it is necessary to have a capital stock of $50,000. Two-thirds of that amount was voted on the spot, and the rest will be raised at another meeting to be held at South Bend this week. It is intended to make the capital stock of the road $1,600,000. Among those present were Clem Studebaker, of South Bend; the Hon. Mortimer Nye, Mayor of Laporte; Gen. Newall Gleason, William Niles, William Biddle, Edward Hawkins, James S. Long, and B. and V. Huncheon, all of Laporte; Arthur Reeves of Richmond, Ind., and John A. Lomax of Chicago.

THE surveyors for the Alma, Winona & Northern road are now working between La Crosse and Winona.

THE parties engaged in making surveys for the Minneapolis & Sault Ste. Marie Road have experienced considerable trouble since winter set in, but there has been no abandonment of the work at any time.

THE prospects for the early construction of the Grand Forks, Crookston & Lake Superior Railway are favorable. The directors of the company organized at Crookston last week are enthusiastic in their work, and are firm in their belief of the future prospects of the road. It is expected by the directors and those who are furthering the work that each town will raise about $10,000; that together with individual stock, will probably give a total of $500,000. The cost of the construction of the road is estimated at $2,000,000, and the placing of the same in operation at about the same amount. The route, as no survey has yet been made, is not definitely known; but the work of surveying will commence next week. The proposed route, however is by way of Fisher's Landing to Crookston, thence in a southeasterly direction between the Red Lake and White Earth Indian reservation, bearing to South Leach lake. The route from this point to Lake Superior is not determined, but will be settled upon by the survey next week.

GRAND FORKS, Dak., Jan. 26—A large and enthusiastic railroad meeeting was held this afternoon at East Grand Forks. The following resolution was introduced and was passed unanimously:

Resolved. That we as citizens and tax-payers of Polk county, Minn., here assembled, do extend our heartiest co-operation to the incorporators of the proposed Grand Forkes Crookston & Lake Superior railroad; we will render all the aid in our power to secure another outlet other than the Manitoba railroad furnishes, and we favor the bonding of Polk county in the sum of $200,000 towards that end.

This Company is incorporated in Minnesota to build a road from the west bank of the Red river, at or near the mouth of the Red Lake river, in Polk county, Minn., via Crookston to the head of Lake Superior, or to a point of connection with some other railroad now built, or hereafter to be built, terminating or connecting with the head of the lake, A branch is to be built to commence in or east of range 44, running in a southeasterly direction to a point on the west bank of the Red river, at or north of the mouth of the Wild Rice river, in Norman county; also a branch from Crookston, or some point west thereof, to the west bank of the Red river, at or near the southwest corner of Polk county; also a branch from some point on the main line, in or east of range 44, via Red Lake Falls to a point on the west bank of the Red river, at or north of the mouth of the Turtle river, in Dakota. The capital stock is $2,000,000. Incorporators; J. R. Clements, E. M. Walsh, William Box, Paul C. Stetten, and Lewis Berthaurne, of Crookston; E. F. Masterson, of East Grand Forks; George H. Walsh, W. T. Collins, W. H. Brown, J. S. Eshelman and John Zerfoss, of Grand Forks. The principal place of business will be at Crookston. It is proposed at present to build from Grand Forks to Leach lake, and from that point to Lake Superior or to Bismarck to connect with the Northern Pacific if a satisfactory traffic agreement can be made with the latter road. A surveying party is to be placed in the field at once to locate the line. J. S. Eshelman has been elected president, P. C. Sletton is vice-president, E. M. Walsh secretary, and E. B. Clements Treasurer.

MILWAUKEE, Wis., Jan. 28.—Surveys have been begun for a new railroad between Schleisingerville, Wis., and Chicago. It is surmised that the branch is intended to give the Wisconsin Central road a direct line to Chicago, and railway men say the Northern Pacific will then buy the Wisconsin Central and this branch, thus having direct connection with Chicago. The surveying party began work Saturday, five mile out of Chicago, and are going in a north-westerly direction through Cook county. They will strike the Wisconsin Division of the Chicago and North-western between Des Plaines and Arlington Heights, pass through Lake County, over the Illinois boundary into Kenosha County, Wis.; thence through Racine County, making a junction with the Kenosha and Harvard Division on the Chicago and North-western between Salem and the Fox River, and with the Racine and South-western Division of the Milwaukee and St. Paul near Dover; will enter Waukesha and Pewaukee and then strike Schleisingerville. No one but the chief engineer of the party knows anything of the project. It is supposed that Chicago capitalists are interested in the line.

BOSTON, Jan. 29.—The majority of the Legislative Committee on Street Railroads will report a bill of incorporating the Meigs system of the elevated street railroad to run from Boston to Cambridge. Five members of the committee dissent.

IRON, METAL AND COAL MARKETS.

PHILADELPHIA, Jan. 30, 1884.

A considerable movement in Foreign Irons is talked of, and will probably take place if the offers of buyers are accepted. $19.50 is offered for Bessemer Iron, and $28 for 20 per cent. Spiegeleisen. Buyers are making efforts to secure 1,000 to 5,000 ton blocks, and business will probably be closed in a few days. American Irons show no change, except that Forge Iron is moving in somewhat larger quantities at $18@$18.50. The activity in Foundry Irons, noticed some time ago, has fallen off because of the unwillingness of buyers to buy ahead, on any terms. A few special brands have sold at $21.50, but the average price paid is $20.50. In Refined Iron no change has taken place, excepting in the way of inquiries for large lots; buyers, however, are diffident on account of the uncertainty as to production. 1.80@2c. are the inside and outside prices. Nails are firm but not active, as consumers are apprehensive of a weakness in the spring, when all the mills resume, and the eastern strikes are settled. Engineering requirements are coming forward slowly, and heavy requirements are still only in sight. Steel Rails, $34@$35, with only small business. There are offers in hand for large lots, but no sales. Crop ends would sell in 1,000 tons lots at $19. Stocks are larger than for some time, but buyers are not urgent.

PITTSBURGH, Jan. 30, 1884.

The Window Glass workers strike is to be settled on Saturday, as a result of a meeting held on Wednesday. Stocks are extremely light, and the demand for glass is very active; hence, it is said that the manufacturers will yield most, and the workers least. Eastern and foreign supplies have come in very slowly, proving entirely inadequate. Manufacturers interested in the manufacture of tin plate in this country, have worked up a strong public sentiment in favor of their movement, and will probably make a strong impression on Congress this year. The Coke interests have about completed their syndicate, and now control over 6,000 ovens. Consumers who have been relying of late on Coke, instead of Anthracite Coal, are apprehensive of an upward tendency; but new coke fields are being developed in other parts of the State, which will prevent any very material advance being made. Inside figures in iron transactions this week were $17 for Forge Iron, $2.40@$2.50 for Nails, $1.60@$1.80 for Merchant Iron, $35@$36 for Steel Rails, $23@$23.50 for Old Rails, $21 for Bessemer Pig. There is more iron moving in a quiet way, than appears on the surface, but consumers, as a rule, are covering immediate requirements only, letting the future take care of itself.

CHICAGO, Jan. 29, 1884.

Northwestern iron markets are beginning to develop a little more activity in consequence of the gradual diminution of stocks in the hands of consumers who have been waiting for a further weakness in prices. The demand for Foreign Irons is very light. Wrought Irons are in very active demand, but stocks are insufficient. The Ore market has been very active, and at present 500,000 tons have been contracted for. Prices are supposed to be $6.50 for Republic ore. Steel Rails are quoted at $35@$36, f.o.b.; Pig Lead, $3.95; Merchant Steel is moving fairly in small lots, but large transactions cannot be effected. Ingot Copper, standard, 14¾; Lake, 15; Sheet Copper, 18½@19¾; demand moderate. The Nail Market shows no activity. Prices $2@$2.60 from car load to jobbing lots. The market is unsettled by rumors as to the uncertain policy of the trade during the spring and summer. Norway and Swedish Irons are neglected. Galvanized Iron is in better request on account of stocks being light. Tank Iron is nominally 2.70 with 10 off for large lots. Angles, 2.70 and Beams 3.60

COAL.

PHILADELPHIA, Jan. 24, 1884.

None of the tidewater markets are overstocked yet, and, according to the indications they will not be, as orders and inquiries from New York and eastern Pennsylvania markets are very encouraging. The resumption of some more mills has helped to increase the line trade, while local requirements are sufficient to keep yard capacity fully engaged in meeting requirements. Prices are firm in consequence of the adherence to restriction, and to the known fact that stocks at shipping points are declining. The market will probably improve for the smaller sizes and remain dull for the larger. Western and eastern inquiry is still improving, but owing to high water freights, eastern shipments are light. Western stocks are being depleted, and it is expected that a heavy demand will develop from that quarter early in February. The Reading Company mined last week 176,640 tons; the Lehigh Valley, 102,000; the Pennsylvania Coal Company, 15,000; the Delaware and Hudson, 55,000 tons. The Clearfield output for last year was 60,000 tons. Soft Coal is moving very slowly; heavy contracts will be placed, as usual, next month.